Water Resource Report 64

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GROUNDWATER RESOURCES IN AND NEAR THE ANTHRACITE BASINS OF SCHUYLKILL AND ADJACENT COUNTIES, PENNSYLVANIA

Albert E. Becher
U.S. Geological Survey

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by Albert E. Becher
U.S. Geological Survey

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GROUNDWATER RESOURCES IN AND NEAR THE ANTHRACITE BASINS OF SCHUYLKILL AND ADJACENT COUNTIES, PENNSYLVANIA

by
Albert E. Becher

ABSTRACT

Groundwater from the Mauch Chunk Formation is an essential potable water resource for communities in and adjacent to the Southern and Western Middle Anthracite fields because much of the groundwater and surface water that discharges from the coal-bearing Llewellyn and Pottsville Formations contains excessive quantities of iron, manganese, and acidity. Only reservoirs and headwater streams in upland areas are suitable for surface-water supply. Fifty-two percent of the average 51 million gallons per day of water used in 1981 was withdrawn by public suppliers; 67 percent of this water came from surface sources. Severe water shortages were experienced by 21 of 31 public suppliers during a drought in the period 1980–81. Groundwater contributions (base flow) sustain the flow of East Mahantango Creek, Shamokin Creek, and the Schuylkill River during years of below-normal precipitation when winter-spring recharge is near or above normal. Average daily base flows of East Mahantango Creek and Shamokin Creek are 370 and 580 gallons per minute per square mile of drainage area, respectively; these flows represent groundwater discharges from the Mauch Chunk and Llewellyn Formations, respectively.

Four potential aquifers are readily accessible to communities in and near the anthracite fields of the Ridge and Valley physiographic province. The Pocono and Pottsville Formations are composed of conglomerate and sandstone. These rocks form high, sinuous ridges adjacent to long valleys underlain by the sandstone, siltstone, and shale of the Mauch Chunk and Llewellyn Formations. Groundwater-flow systems in these rocks grade laterally from confined to unconfined and range in area from less than one to tens of square miles.

Some layered flow systems may not be connected vertically except through boreholes. The natural flows of systems in the Llewellyn Formation have been changed greatly by underground mining. High-yield flowing wells have been developed in confined systems of the Mauch Chunk Formation near the nose of plunging synclines and in the Pottsville where the land surface and rock layers slope in the same direction.

Wells in the Pocono and Llewellyn Formations yield only small supplies of water (15 to 20 gallons per minute). One of every two wells drilled for maximum yield in either the Mauch Chunk or Pottsville Formation yields in excess of 75 gallons per minute. Maximum yields of single wells in the Mauch Chunk and Pottsville Formations are 800 and 400 gallons per minute, respectively.

A specific yield of 0.034 was calculated for the zone of water-table fluctuation in a 1-square-mile groundwater basin draining the Mauch Chunk Formation. Large-production wells in the Pottsville or Mauch Chunk Formation spaced less than 1,500 feet apart along strike may significantly affect the yields of individual wells.

Water from the Pocono and Pottsville Formations is very low in dissolved solids but may contain undesirable amounts of iron and manganese, especially water from the Pottsville. Median dissolved solids are 52 and 53 milligrams per liter for the Pocono and Pottsville, respectively. Iron and manganese exceed drinking water standards in water from about 80 percent of the wells in the Llewellyn Formation. Wells that intercept mine water will contain 3 to 40 times the concentrations of constituents present in other areas. Excessive iron, manganese, sulfate, dissolved solids, and corrosiveness are the major properties that make mine water poor in quality.

Mining has not affected the water quality of the Mauch Chunk Formation nor significantly changed the water quality of the Pottsville Formation distant from mines.

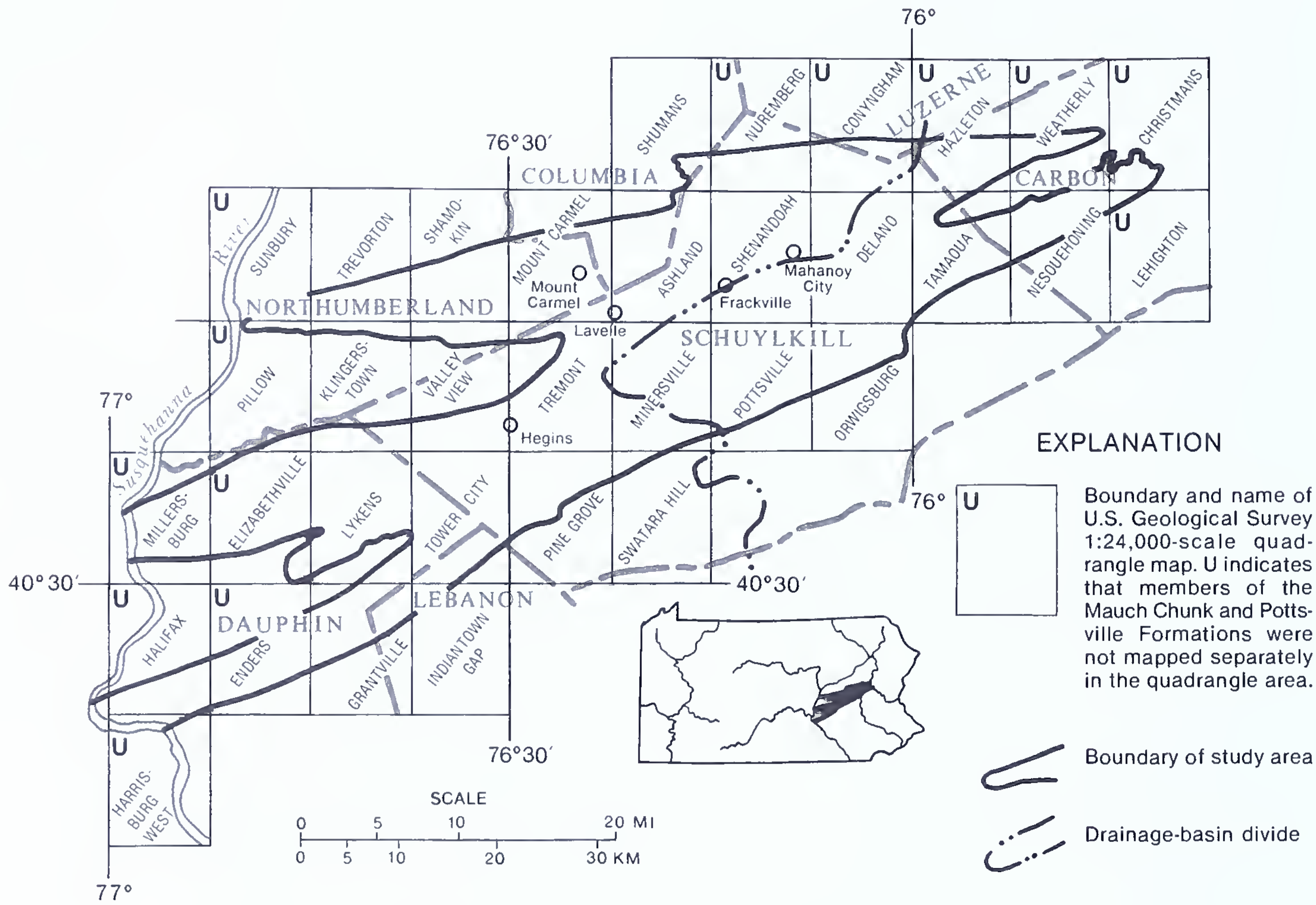


Figure 1. Location of the study area in east-central Pennsylvania.

INTRODUCTION

An earlier planning study (Becher, 1980) revealed that groundwater resources, especially from the Mauch Chunk Formation, are essential to communities in and adjacent to the Southern and Western Middle Anthracite fields (Figure 1). Groundwater in the coal-bearing Llewellyn and Pottsville Formations contains objectionable quantities of iron and manganese and is corrosive and acid throughout most areas of occurrence. Degradation of the water is a natural chemical effect from solution of iron sulfide minerals in the coal and surrounding rock, but mining has exposed more mineral matter and greatly increased the degradation of the water resources. The discharge of poor-quality water from the mine areas precludes the use of a receiving stream as a potable water resource. As a result, only some headwater streams and reservoirs draining upland areas of the coal-bearing rocks can be used for water supply. During drought, these resources dwindle rapidly. Unconfirmed reports of acid mine drainage contamination of the adjacent Mauch Chunk Formation in several places suggested a possible expansion of the water-quality problem into the only remaining aquifer reasonably accessible to communities.

PURPOSE AND SCOPE

This study is a 2½-year expansion of the earlier planning study. The purpose of the investigation and this report is to (1) describe the occurrence, availability, and quality of groundwater in the 880-square-mile study area (Figure 1); (2) determine the extent, if any, of contamination of the aquifers by acid mine drainage; and (3) evaluate the potential for future contamination by acid mine drainage. The report provides information to planning organizations, municipalities, rural communities, consultants, well-drilling firms, and other industries who want to develop groundwater or guide the mining of coal to prevent future contamination of vital water resources. Individuals interested in drilling wells for their homes or farms can benefit by using the information to select favorable drilling sites, estimate costs based on well-depth and casing data, and anticipate possible development and water-quality problems.

The scope of study included a field inventory to expand the well data base, borehole geophysical logging to detect yield zones and vertical flow, field and laboratory chemical analyses of well water to determine water-quality characteristics and problems, and field reconnaissance of sites having the greatest potential for aquifer contamination by acid mine drainage. This investigation continues the ongoing cooperative program between the U.S. Geological Survey and the Pennsylvania Geological Survey to describe the groundwater resources of the state.

PHYSICAL AND GEOHYDROLOGIC SETTING

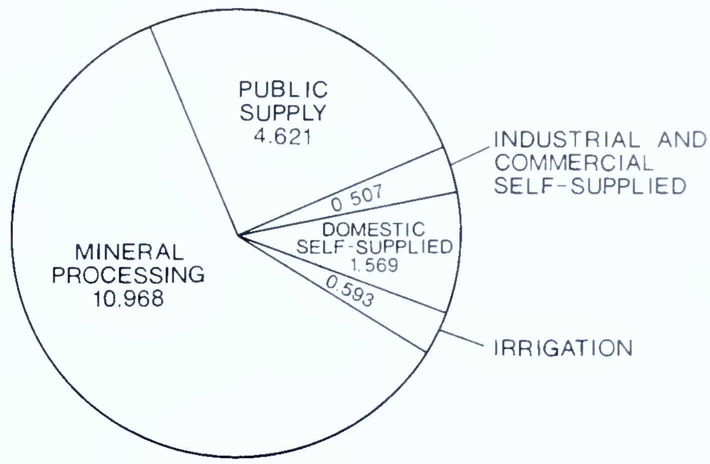
Aquifers accessible to the Anthracite region are entirely within the Appalachian Mountain section of the Ridge and Valley physiographic province. High, northeast-trending ridges composed of conglomerate and sandstone separate long valleys through much of the area. Altitudes on the ridge tops generally range from 1,200 to 1,800 feet above sea level, and altitudes in valley bottoms range from 500 to 900 feet above sea level. Relief between ridges and valleys ranges from 500 to 1,000 feet.

Drainage from the area is divided between two major river basins (Figure 1), the Delaware to the east and the Susquehanna to the west. Tributary streams flow essentially parallel to the ridges, but some divergence occurs around ridge ends and in broader valleys. A few larger streams, such as the Schuylkill and Little Schuylkill Rivers, flow to the south across the grain of geology and topography through water gaps cut into the ridges. Valleys underlain by coal-bearing formations have been, and still are, mined by both underground and strip methods, leaving a greatly disturbed, bare or thinly vegetated landscape partly or wholly covered by waste piles. Ridges, upland plateaus, and their slopes commonly are forested, although some areas have been mined and have landscapes similar to those in mined valleys. Valleys underlain by formations that do not contain coal that are adjacent to the anthracite-bearing formations are extensively farmed. Boroughs and villages occupy all types of terrain except ridge tops. Those in coal areas commonly obtain water elsewhere, as much as 5 miles away.

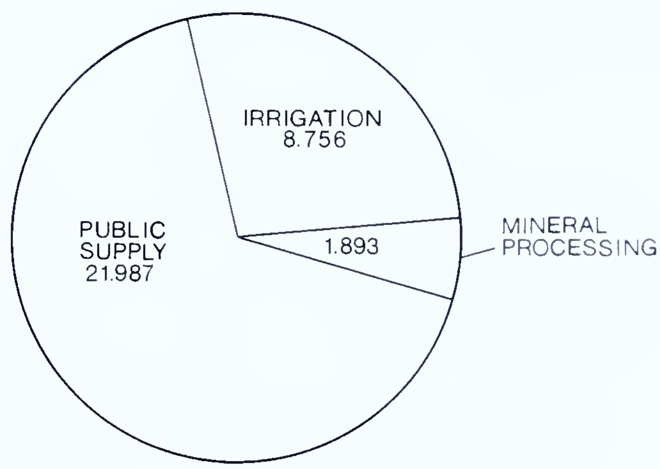
WATER USE

In 1981, about 51 Mgal/d (million gallons per day) of water was withdrawn in the study area from all sources for all uses, excluding livestock, based on data provided by the Pennsylvania Department of Environmental Resources (1980, 1981). Slightly more than half of the water was withdrawn for public-supply use and an additional 25 percent for the mineral industry. Of the remainder, 18 percent was used for irrigation, 3 percent for self-supplied residential purposes, and 1 percent for self-supplied commercial and industrial needs. Groundwater withdrawals were about 18 Mgal/d, or 35 percent of the total (Figure 2). Mine dewatering and water for coal processing accounted for about 60 percent of all groundwater withdrawn. Public supplies accounted for 67 percent of all surface water withdrawn.

Water use for public supply declined about 13 percent from 1970 to 1981, although the population decreased by only about 4 percent. Conservation efforts reinforced by drought in 1980 and the effects of economic recession may explain some of the decline.



GROUNDWATER USE



SURFACE-WATER USE

Figure 2. Estimated water use for 1981 in and near the anthracite basins of Schuylkill and adjacent counties. Numbers represent millions of gallons per day.

All but six of the public suppliers shown in Table 1 imposed water use restrictions on users during part of the time from July 1980 through March 1981. Severe water shortages were experienced by 21 of these public suppliers during the drought. Several reservoirs were dry and many were extremely low. Well production was significantly reduced by low groundwater levels.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the cooperation and help of the many homeowners, organizations, and company officials and their staffs who allowed access to their property for the collection of the data used in this report. Special thanks are due Mr. Stanley Dobies, Mr. Jerry Pillus, and the Blythe Township Municipal Authority for allowing continuous access to the authority wells and providing help during inclement weather and during packer tests of their wells. Similar thanks are extended to the managers and staff of the Borough of Ashland, Borough of Mount Carmel, and the Schuylkill County Municipal Authority for help and the long-term use of their wells and springs for measurements, pumping tests, and well-logging activities. Many others provided cooperation, help, and data concerning public-supply wells of the Keystone Water Company at Trevorton and Frackville, of the Williamstown Borough Authority, and of the Jim Thorpe Water Department. The Pennsylvania Geological Survey and the Susquehanna River Basin Commission provided well-inventory and water-quality data to the study, for which the author is grateful.

Table 1. *Inventory of Public Water-Supply Facilities*

Name of supplier	Service area	Population served, 1980	Pumpage (Mgal/d) in 1981		Number of wells and springs	Other sources
			Groundwater	Total		
CARBON COUNTY						
Jim Thorpe Water Department	Jim Thorpe Borough	5,263	0.489	0.861	3 wells in Mauch Chunk Formation	Mauch Chunk Creek and Ruddles Run
Lansford-Coaldale Joint Water Authority	Lansford and Coaldale Boroughs	7,268	.700	.742	3 wells	—
Nesquehoning Water Authority	Nesquehoning Borough	3,346	.350	.350	—	Purchased from Lansford-Coaldale Joint Water Authority
Summit Hill Municipal Water Authority	Summit Hill Borough	3,418	.342	.342	3 wells in Mauch Chunk Formation	—
DAUPHIN COUNTY						
Elizabethville Water Company	Elizabethville Borough	1,531	.093	.093	3 wells in Mauch Chunk Formation	—
Gratz Borough Authority	Gratz Borough	678	.030	.030	1 well and 2 springs in Mauch Chunk Formation	—
Loyalton Water Association	Village of Loyalton	133	.009	.009	2 wells in Mauch Chunk Formation	—
Lykens Borough Authority	Lykens Borough and Wiconisco Township	3,747	—	.568	—	Rattling Creek

Table 1. *(Continued)*

Name of supplier	Service area	Population served, 1980	Pumpage (Mgal/d) in 1981 Groundwater	Total	Number of wells and springs	Other sources
		DAUPHIN COUNTY *(continued)*				
Millersburg Area Water Authority	Millersburg Borough and part of Upper Paxton Township	3,785	.475	.475	9 wells and 5 springs in Mauch Chunk Formation	—
Williamstown Borough Authority	Williamstown Borough and Williams Township	2,697	—	.343	—	East Branch of Rattling Creek
		NORTHUMBERLAND COUNTY				
Excelsior Water Association	Village of Excelsior	111	.005	.005	1 spring in Llewellyn Formation	—
Mount Carmel Municipal Water Authority	Mount Carmel Borough and part of Mount Carmel Township	10,789	.020	.726	2 springs in Llewellyn Formation	Purchased from Roaring Creek Water Company
Roaring Creek Water Company	Shamokin Borough and Coal Township	21,341	.031	3.199	2 wells in Mauch Chunk Formation	South Branch of Roaring Creek and Trout Run
	Centralia (Columbia County)	1,017	—	.319	—	do.
	Girardville Borough	2,268	—	.366	—	do.
	Kulpmont Borough	3,675	—	.478	—	do.
	Marion Heights Borough and parts of several townships	986	—	.137	—	do.
Trevorton Water Company	Trevorton Borough	2,251	—	.163	1 well in Mauch Chunk Formation	Purchased from Roaring Creek Water Company
		SCHUYLKILL COUNTY				
Ashland Borough Water Department	Ashland Borough and part of Butler Township	4,970	.670	.670	1 well and 4 springs in Mauch Chunk Formation	—
Ashland State General Hospital	Hospital	190	—	.032	1 (standby) well in Mauch Chunk Formation	Reservoir on tributary to Little Mahanoy Creek
Blythe Township Municipal Authority	Boroughs of Middleport and New Philadelphia; parts of Blythe, Branch, Cass, Foster, East Norwegian, New Castle, Reilly, and Schuylkill Townships	9,403	—	1.133	—	Silver Creek; Moss Glen and Crystal Reservoirs

Table 1. *(Continued)*

Name of supplier	Service area	Population served, 1980	Pumpage (Mgal/d) in 1981		Number of wells and springs	Other sources
			Groundwater	Total		
SCHUYLKILL COUNTY *(continued)*						
Butler Township Water Company	Borough of Gordon; villages of Germanville Lavelle, Locustdale, Big Mine Run, Merrian, Preston Hill, and Homesville	2,355	—	.312	—	East and West Branches of Rattling Run
Hegins Township Authority	Villages of Hegins and Valley View	2,590	.267	.267	3 wells and 6 springs in Mauch Chunk Formation	—
Keystone Water Company, Frackville District	Frackville Borough; parts of Butler and Mahanoy Townships	6,511	.507	.507	5 wells	—
Mahanoy Township Authority	Boroughs of Mahanoy City and Gilberton; villages of Boston Run, St. Nickolas, Maple Hill, Ellen Gowan, and Yatesville	7,665	—	.619	1 (standby) well	Reservoirs on Mud Run, Waste House Run, and others
Mary-D Community Association	Village of Mary-D	450	.019	.019	1 spring in Pottsville Formation	—
Minersville Municipal Water Authority	Minersville Borough; parts of Cass, Branch, Norwegian, and New Castle Townships	7,594	—	.910	—	Wheeler Creek, Wagner Run, and Dry Run
Morea Citizens Water Company	Village of Morea	198	.059	.059	1 well in Pottsville Formation	—
Mountain Water Authority of Joliett	Village of Joliett	370	No data		2 wells and 1 spring	—
New Boston Water Association	Village of New Boston	180	.015	.015	3 springs in Pottsville Formation	—
Schuylkill County Municipal Authority	City of Pottsville; Boroughs of St. Clair, Port Carbon, Mt. Carbon, Palo Alto, and Mechanicsville; parts of New Castle, East Manheim, and Norwegian Townships	28,975	.430	4.058	2 wells in Mauch Chunk Formation	Reservoirs on Indian Run, Kaufman Run, Tar Run, Wolf Creek, and Eisenhuth Run
Ringtown Water Works	Ringtown Borough; parts of Union Township	837	.025	.025	1 spring in Mauch Chunk Formation	—

Table 1. *(Continued)*

Name of supplier	Service area	Population served, 1980	Pumpage (Mgal/d) in 1981		Number of wells and springs	Other sources
			Groundwater	Total		
SCHUYLKILL COUNTY *(continued)*						
Shenandoah Borough Municipal Authority	Shenandoah Borough; parts of West Mahanoy, Union, and Butler Townships	11,523	—	1.993	—	Whiskey Mill Creek, Dreshers Run, Kehley Run, and Raven Run
Borough of Tamaqua	Tamaqua Borough; parts of Rush, Schuylkill, and Walker Townships	9,891	—	6.524	1 (standby) well in Mauch Chunk Formation	Still Creek and Owl Creek Reservoirs
Tower City Borough Authority	Tower City and most of Porter Township	3,612	.085	.256	2 wells in Mauch Chunk Formation	Tributary to Wiconisco Creek
Tremont Gas and Water Company	Tremont Borough	1,796	No data		—	Tierney Stream and Upper Poplar Creek

GEOLOGIC AND HYDROLOGIC PROPERTIES OF THE ROCKS

Geology is the primary control on the occurrence and movement of all water that enters the area. The four geologic formations, their members, and a summary of their geohydrologic properties are given in Table 2. Contrasts between formations in their resistance to weathering and erosion, and the structural framework of folds and faults, have created the alternating ridge and valley topography of the region. Thick, coarse conglomerate and sandstone beds of the Pottsville and Pocono Formations underlie the major ridges; sequences of siltstone, shale, and sandstone of the Llewellyn and Mauch Chunk Formations underlie the major valleys. The areal distribution of formations and the locations of major faults are shown on Plate 1. Details of the geology are shown on the published geologic-quadrangle and coal-investigations maps of the region listed in the ''References'' section of this report. Discussions of the stratigraphy, structure, and coal resources have been published by the U.S. Geological Survey (Wood, Trexler, and Arndt, 1962; Wood, Trexler, and Kehn, 1969).

LLEWELLYN FORMATION

Description

Gray and brown sandstone, siltstone, and shale containing lenticular masses of conglomerate and conglomeratic sandstone make up the bulk of the Pennsylvanian-age Llewellyn Formation. More than 40 beds of anthracite, many persistent throughout the area, are interbedded with these rocks. In most places the coal has been mined out to depths of several hundred to more than 1,000 feet. Erosion has removed part of the Llewellyn Formation, leaving a remnant ranging from a thin wedge to a maximum reported thickness of 3,500 feet.

Water-Bearing Properties

The median specific capacity of 19 small-production wells in the Llewellyn Formation was 0.34 (gal/min)/ft (gallons per minute per foot), and the median reported yield was 18 gal/min (gallons per minute). Yields of six large-production wells were only slightly greater, although their median depth of 306 feet was 2.5 times the depth of small-production wells; the maximum yield reported was 70 gal/min. Of 62 water-bearing zones reported, 31 were penetrated in the 51- to 100-foot depth range, 11 in the 0- to 50-foot range, and 10 in the 101- to 150-foot range.

Water Quality

Field determinations and chemical analyses from 12 wells indicate that water from the Llewellyn Formation ranges from moderately hard to hard and that the dissolved-solids concentration is moderate to high.

Table 2. *Generalized Description and Water-Bearing Properties of the Geologic Units*

System and series	Geologic unit	Thickness (feet)	Character of rocks	Water-bearing properties
Pennsylvanian	Llewellyn Formation	3,500 maximum, top eroded	Gray and brown sandstone, siltstone, shale, and some conglomerate; coal beds are abundant.	Poor aquifer. Most areas are contaminated by acid mine water. In unmined areas, the unit yields domestic supplies of water that is commonly high in iron and manganese. Median and maximum reported yields are 20 and 100 gal/min, respectively. Water is moderately hard.
	Pottsville Formation	350–1,500	Gray (some brown) cobble and pebble conglomerate, and conglomeratic sandstone, coarsest in the upper part. Includes some sandstone, siltstone, shale, and coal. Three members are mapped in many areas.	Median and maximum reported yields of nondomestic wells are 70 and 400 gal/min, respectively. More than one third of the wells have water high in iron and corrosively acid. Water is soft and low in dissolved solids. Data are insufficient to evaluate members separately.
Lower Pennsylvanian and Upper Mississippian	Mauch Chunk Formation, upper member	0–900; average 600	Gray, red, and brown conglomerate, medium-grained sandstone, siltstone, and shale. Transitional between Pottsville Formation and middle member of Mauch Chunk Formation. Poorly exposed.	Median and maximum reported yields of nondomestic wells are 35 and 213 gal/min, respectively. Half of the wells have water high in iron and manganese. Water is soft and low in dissolved solids.
Mississippian	Mauch Chunk Formation, middle member	2,000–6,000	Red or green siltstone, mudstone, shale, and very fine grained sandstone.	Good aquifer. Median and maximum reported yields of nondomestic wells are 70 and 393 gal/min, respectively. About one twelfth of the wells have water high in iron and manganese. Water is commonly soft but ranges from soft to hard; dissolved-solids content ranges from low to high.
	Mauch Chunk Formation, lower member	400–800	Grayish-red and brown shale, siltstone, and sandstone; some conglomerate. Poorly exposed. Often mapped with middle member.	Insufficient data are available to evaluate the aquifer. Probably similar in yield and water quality to the middle member of the Mauch Chunk Formation.
	Mauch Chunk Formation, undifferentiated	4,500–6,000	Grayish-red, brown, and green siltstone, shale, and very fine grained sandstone. A few calcareous nodules, lenses, or thin beds are present.	Good aquifer. Median and maximum reported yields of nondomestic wells are 100 and 800 gal/min, respectively. Water from about one tenth of the wells is high in iron. The water is commonly moderately hard but ranges from soft to hard and has low to moderate dissolved solids.
	Pocono Formation	700–1,700	Gray sandstone, conglomeratic sandstone, and conglomerate; some siltstone, shale, and thin lenses of coal.	Insufficient data are available to evaluate the aquifer. Few wells are present in this unit because it underlies high ridges. Probably will yield domestic supplies to most wells. Water from one of the four samples is high in iron. The water is soft and low in dissolved solids.

Excessive iron and manganese concentrations are serious problems even in places distant from coal mines. The median concentrations of dissolved iron and manganese from well water were 0.81 and 0.14 mg/L (milligrams per liter), respectively. Iron concentrations in 9 of 12 samples and manganese in 7 of 9 samples exceeded the U.S. Environmental Protection Agency (1983) drinking water standards of 0.3 mg/L for iron and 0.05 mg/L for manganese.

Evaluation of the Aquifer

Small-production wells can be developed in the Llewellyn Formation away from mined areas. Water from these wells is very likely to contain undesirable amounts of iron and manganese. Large supplies of very poor quality water can be developed from abandoned mines for cooling or heating purposes. Treatment costs for other uses are generally prohibitive.

POTTSVILLE FORMATION

Description

Rocks of the Pottsville Formation, of Pennsylvanian age, underlie high ridges or small upland plateaus and consist chiefly of gray coarse conglomerate and conglomeratic sandstone. Interbedded with these rocks are sandstone, siltstone, and shale, which make up about 30 percent of the formation. The formation also contains 13 beds of coal that are persistent. The thickness of the Pottsville varies from about 350 feet in the northeast to 1,500 feet in the southwest.

Water-Bearing Properties

Most wells in the Pottsville Formation were drilled to supply public systems in adjacent population centers. The rugged, forested ridges underlying the formation are largely uninhabited. For large-production wells, the median specific capacity was 3.3 (gal/min)/ft (4 wells), and the median reported yield was 75 gal/min (11 wells). A maximum yield of 400 gal/min was reported.

The median depth of large-production wells (11 wells) was 500 feet. Of the 20 water-bearing zones reported from all wells, 11 were in the 51- to 100-foot depth range, 6 were in the 201- to 300-foot depth range, and the deepest zone reported was at 548 feet.

Water Quality

Laboratory and field analyses indicate that water from the Pottsville Formation is soft and low in dissolved solids. The concentration of iron in 7 of 15 samples exceeded the U.S. Environmental Protection Agency (1983) drinking water standard. In 7 of 13 samples, the U.S. Environmental Protection Agency drinking water standard for manganese was exceeded. The median concentrations of iron and manganese were 0.15 and 0.08 mg/L, respectively. Water is commonly acidic and corrosive, at least in part due to chemical reactions with the coal-bearing rocks. The median pH of 15 field determinations was 5.9, and the pH ranged from 4.0 to 7.2. Water from some public-supply wells that slightly exceeds U.S. Environmental Protection Agency standards is used after dilution with water of better quality.

Evaluation of the Aquifer

Yields of at least 75 gal/min can be developed in half of the wells in the Pottsville Formation. Moderately corrosive water containing undesirable quantities of iron and manganese reduces the worth of this otherwise excellent resource.

MAUCH CHUNK FORMATION

Description

Red, green, and brown siltstone, shale, mudstone, and very fine grained sandstone are the chief rock types of the Mauch Chunk Formation, of Mississippian and Pennsylvanian age.[1] Gray sandstone and conglomerate, similar to rocks of the underlying Pocono and overlying Pottsville Formations, are interbedded with typical Mauch Chunk rocks in the lower and upper members of this unit. These members underlie talus-covered slopes and commonly are missing from the sequence due to faulting. They have minor areal extent but, where present, each averages 600 feet in thickness. They have been mapped in all quadrangles not marked otherwise on the location map (Figure 1). The total thickness of the Mauch Chunk Formation ranges from 2,000 to 6,000 feet.

Water-Bearing Properties

The median specific capacity and reported yield of wells drilled for large production in the Mauch Chunk Formation were 1.1 (gal/min)/ft (43 wells) and 75 gal/min (71 wells), respectively. For wells

[1]The Mauch Chunk Formation is shown on Plate 1 of this report as Mississippian in age, following the usage of Berg and others (1980); however, it is recognized that the upper member of the Mauch Chunk is partly Pennsylvanian in age.

drilled for small-production use, the comparable statistics were 0.24 (gal/min)/ft (143 wells) and 18 gal/min (180 wells). A yield of 800 gal/min was the maximum reported. The median specific capacity and reported yield of wells in both the upper and lower members were about half those of the middle member and undifferentiated Mauch Chunk. The median depths of small-production and large-production wells were 150 and 300 feet, respectively. Of 412 water-bearing zones reported, 43 percent were encountered in the depth range of 51 to 100 feet, and 88 percent were encountered at depths of less than 200 feet.

A specific yield of 0.034 (3.4 percent) was calculated based on measured stream discharge and water-level decline during a 3-day period in a 1-square-mile basin, south of Ashland, that drains the Mauch Chunk Formation. Only one of several attempts to obtain field data for this purpose was successful because rain-induced recharge to the aquifer occurred between periods of measurements. The value determined for specific yield is reasonable, but it may not be representative of the aquifer because the groundwater basin is small in area, and a single determination is not adequate to define this property.

Water Quality

Chemical analyses of 61 samples of groundwater from the Mauch Chunk Formation were evaluated. The water contains low to moderate amounts of dissolved solids and is soft to very hard.

The concentration of iron in 9 of 58 samples exceeded the U.S. Environmental Protection Agency (1983) drinking water standard. One of 42 samples had a concentration of nitrate in excess of the recommended standard (1983) of 10 mg/L for drinking water. The median concentrations of iron and nitrate were 0.05 and 2 mg/L, respectively.

Evaluation of the Aquifer

Half of the wells drilled for large yields will produce more than 75 gal/min from the Mauch Chunk Formation. However, yields from the upper and lower members will be much less than those from the middle member. Single well yields of more than 200 gal/min can be developed in areas where groundwater is under confined conditions and wells are likely to flow naturally. Half of the domestic and commercial wells yield more than 18 gal/min. Wells drilled to depths greater than 200 feet are not likely to encounter a water-bearing zone. However, wells that have yielded large supplies of water at shallow depths are more likely to have increased production by deepening than are wells that have yielded little or no water.

Water of acceptable quality can be readily obtained from the Mauch Chunk Formation. Undesirable concentrations of iron are most likely to occur in water from the upper member but may occur in any part of the formation.

POCONO FORMATION

Description

The Pocono Formation (Mississippian age) unconformably overlies the Spechty Kopf Formation (Mississippian and Devonian age) and forms a narrow, prominent, sinuous ridge throughout the area of study. Gray, crossbedded, coarse-grained sandstone and conglomerate make up the bulk of the formation; some thin interbeds of shale and siltstone also are present. Thin lenses of coal are commonly associated with the shale. The formation ranges in thickness from about 700 to 1,700 feet and thins to the north.

Water-Bearing Properties

Few wells are drilled in this formation because it underlies rugged, forested ridges. The specific capacities of two wells were 0.13 and 0.8 (gal/min)/ft at reported yields of 20 and 10 gal/min, respectively. Two water-bearing zones were reported for one well at depths of 160 and 240 feet. The median and maximum well depths for three wells were 247 and 814 feet, respectively.

Water Quality

Water from the Pocono Formation is very low in dissolved solids but may contain undesirable concentrations of iron. The median dissolved-solids content of three samples was 52 mg/L, and the median iron content of four samples was 0.16 mg/L. One sample contained 3.4 mg/L of iron. The median pH was 5.9.

Evaluation of the Aquifer

Small supplies of water are available, although data are insufficient to evaluate the potential for larger supplies. Transport of drilling equipment may be difficult on the steep slopes, and drilling will be slow. Flowing wells may be developed on lower slopes that parallel dip. Water is soft but may contain excessive iron.

HYDROLOGIC SYSTEM

The hydrologic system is the natural cycle of water movement through the environment. Water enters the area as precipitation or streamflow and leaves as water vapor in the atmosphere (evapotranspiration), overland flow, or percolation underground that ultimately reaches streams flowing to the Susquehanna River or Delaware River. Major streams draining the area are Shamokin Creek, Mahanoy Creek, East Mahantango Creek, Wiconisco Creek, Stony Creek, Swatara Creek, and the Schuylkill and Little Schuylkill Rivers.

WATER BUDGET

A water budget is a quantitative expression of the balance between the major components of water moving in and out of the area. It is a measure of the total water resource available without depleting storage under natural conditions. A simplified equation of this balance is:

$$P = R_s + R_g + ET + \Delta S$$

where

- P is precipitation,
- R_s is the surface runoff component of total streamflow,
- R_g is the groundwater discharge component of total streamflow (base flow),
- ET is water losses (chiefly evaporation and transpiration), and
- ΔS is the change in groundwater storage.

The large variation in precipitation on the area, lack of flow data for many streams, complexity of the terrain and geology, and man-made effects prevented the preparation of a comprehensive water budget for this report. However, water budgets were prepared that show the magnitude of variability in the budget components between several streams, and reasons are suggested for the variability.

Adequate daily values of streamflow were available for three streams largely draining the geologic units studied (U.S. Geological Survey, 1955–83, 1976–83). Water budgets for Shamokin Creek, East Mahantango Creek, and the Schuylkill River above Landingville were computed and analyzed for periods ranging from 8 to 29 water years. Within the longer water-budget period, cycles of above- and below-normal precipitation lasting several years were selected that begin and end at similar base flows. It was assumed that if base flows were similar, net changes in groundwater storage could be assumed to be minimal. The drought of 1980 and 1981 was included so that water suppliers could compare declines in groundwater and surface-water discharges with the timing of drought impact on their resources. Differences in soil-moisture content were minimized by using periods of several years' duration and avoiding periods that were preceded by or ended with major September precipitation. Base flow was separated from total flow using the "Sliding Interval Method" developed for computer analysis of daily streamflow by Pettyjohn and Henning (1979).

East Mahantango Creek Basin

East Mahantango Creek was selected for budget evaluation because it has a long record of streamflow data and is the only gaged stream in the region that does not drain substantial areas of anthracite-bearing rocks. Drainage of the Mauch Chunk Formation outcrop area constitutes 77 square miles, or 47 percent of the stream basin. Most of the remaining area is underlain by rocks similar to the Mauch Chunk.

Annual water budgets for a 29-year period are shown in Table 3. Precipitation for the period averaged 42.4 inches. The average annual streamflow, at the gage, for the same period is equivalent to 18.4 inches of precipitation on the drainage basin area. Groundwater discharge averages 61 percent and ranges from 43 to 72 percent of annual streamflow.

Hydrographs of total flow and base flow for selected periods show temporal variation in the relationship between streamflow and groundwater discharge (Figures 3 and 4). A 3-year wet period was selected from a multiyear period of above-normal precipitation in the 1970's. Base flow was about 70 ft^3/s (cubic feet per second) at the beginning of the period in 1971 and about 80 ft^3/s at the end of the period in 1974. Similarly, a 3-year dry period was selected from a multiyear period of below-normal precipitation that occurred in the 1960's. Base flow was about 25 ft^3/s at the beginning of the period in 1963 and about 25 ft^3/s at the end of the period in 1966.

Winter-spring precipitation is important both for recharging the groundwater system and sustaining streamflow during the remainder of a water year. In 1972, during the wet period, direct runoff and groundwater discharge were above normal. However, of the 21.7 inches of direct runoff (Table 3), 14.1 inches occurred in June as a result of tropical storm Agnes. Direct runoff for the year would have been below or near normal without the Agnes storm, as precipitation was well below normal for the suc-

Table 3. *Water Budget for the East Mahantango Creek Basin*[1]

Water year[3]	Precipitation[2] P (inches)	+ Direct runoff R_s (inches)	+ Groundwater discharge R_g (inches)	Groundwater discharge (percent of streamflow)	+ Water losses ET (inches)	Water losses (percent of precipitation)
1954	38.6	5.3	8.2	60	25.1	65
1955	37.4	5.4	7.8	59	24.2	65
1956	49.8	6.2	13.5	69	30.1	60
1957	35.0	5.3	11.6	69	18.1	51
1958	50.0	8.4	12.4	59	29.2	58
1959	33.4	4.4	7.7	64	21.3	64
1960	55.2	7.8	12.7	62	34.7	63
1961	37.0	5.1	11.9	70	20.0	54
1962	42.7	4.5	7.5	63	30.7	72
1963	36.2	3.7	9.7	72	22.8	63
1964	35.8	7.3	10.5	59	18.0	50
1965	30.1	2.3	5.1	69	22.7	75
1966	32.8	3.7	7.3	66	21.8	67
1967	38.5	5.0	11.1	69	22.4	58
1968	40.0	5.9	10.6	64	23.5	59
1969	37.5	3.9	8.1	68	25.5	68
1970	39.5	8.1	12.1	60	19.3	49
1971	40.7	6.2	12.8	67	21.7	53
1972	55.8	21.7	16.4	43	17.7	32
1973	48.5	7.3	13.7	65	27.5	57
1974	49.5	7.6	13.8	64	28.1	57
1975	52.1	14.2	15.3	52	22.6	43
1976	40.8	5.4	12.1	69	23.3	57
1977	48.6	11.9	12.6	52	24.1	50
1978	54.6	12.4	17.9	59	24.3	45
1979	48.6	11.9	14.5	55	22.2	46
1980	35.9	6.9	12.6	65	16.4	48
1981	40.8	5.0	6.0	54	29.8	73
1982	44.9	5.4	10.7	66	28.8	64
29-year average	42.4	7.2	11.2	61	24.0	57

[1]Drainage area 162 square miles.
[2]Precipitation at Shamokin.
[3]October 1–September 30.

ceeding 3 months (Figure 3). Groundwater discharge derived from above-normal winter-spring recharge sustained flow during the summer of 1972.

The effect of winter-spring recharge on groundwater discharge also is shown by conditions during the dry period. In 1964, a year of below-normal precipitation (Figure 4), groundwater discharge was near normal (Table 3) because winter-spring precipitation was near normal. In 1965 and 1966, winter-spring precipitation and annual precipitation were below normal, which resulted in below-normal groundwater discharge and total streamflow.

Precipitation, direct runoff, and groundwater discharge were above average in 1979, but in 1980, groundwater discharge was 13 percent above normal, which sustained streamflow at or near normal levels. However, precipitation and direct runoff were both about 9 percent below average.

Shamokin Creek Basin

About 90 percent of the drainage area above the gage on Shamokin Creek is underlain by intensively mined Llewellyn and upper Pottsville rocks. Precipitation for the 28-year period shown in Table 4 averaged 42.6 inches, and streamflow at the gage for the same period averaged the equivalent of 21.5 inches of precipitation on the basin. Groundwater

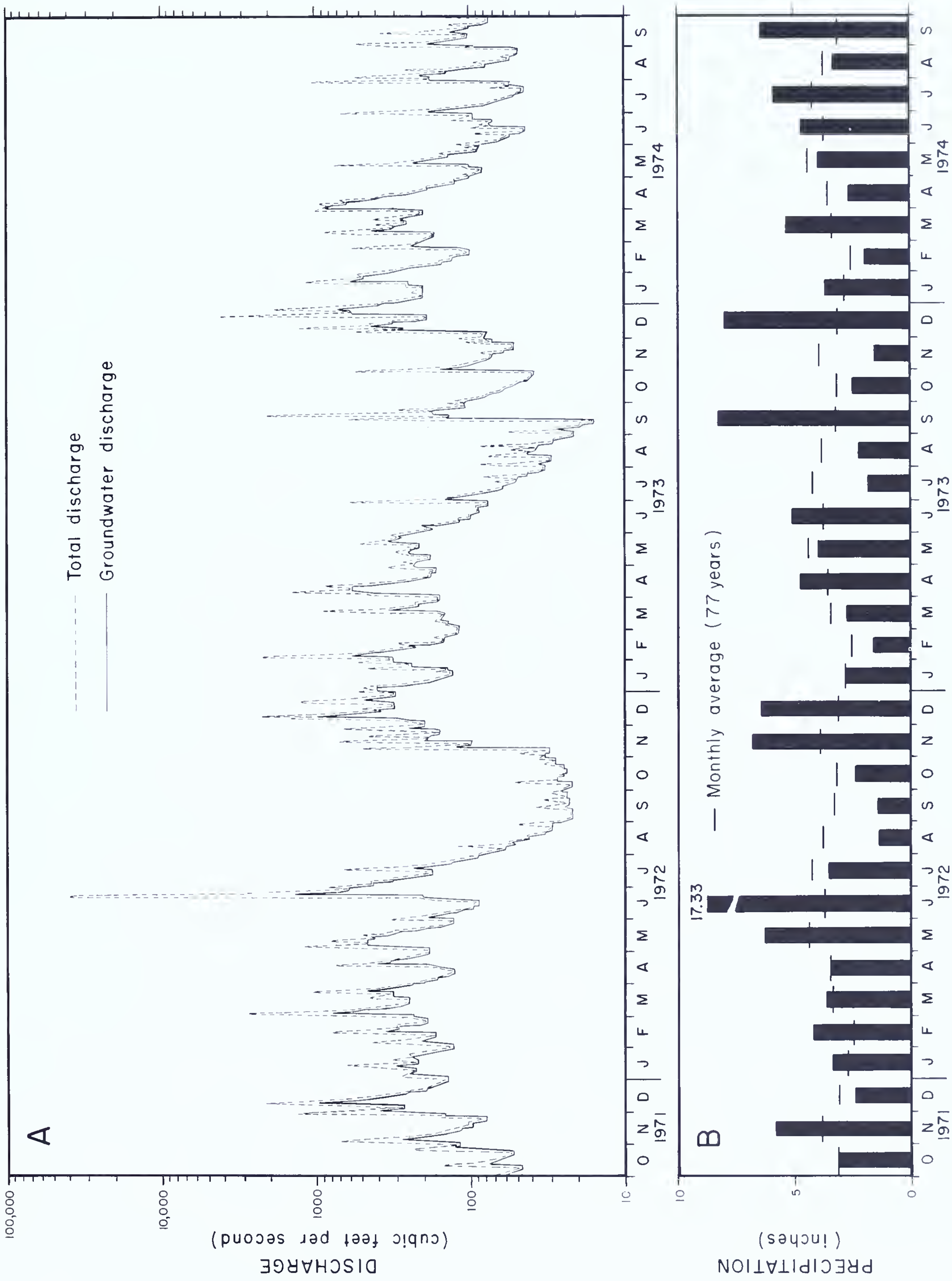


Figure 3. Hydrographs for East Mahantango Creek during a wet period, 1972–74. A, total and base-flow discharge; B, precipitation at Shamokin.

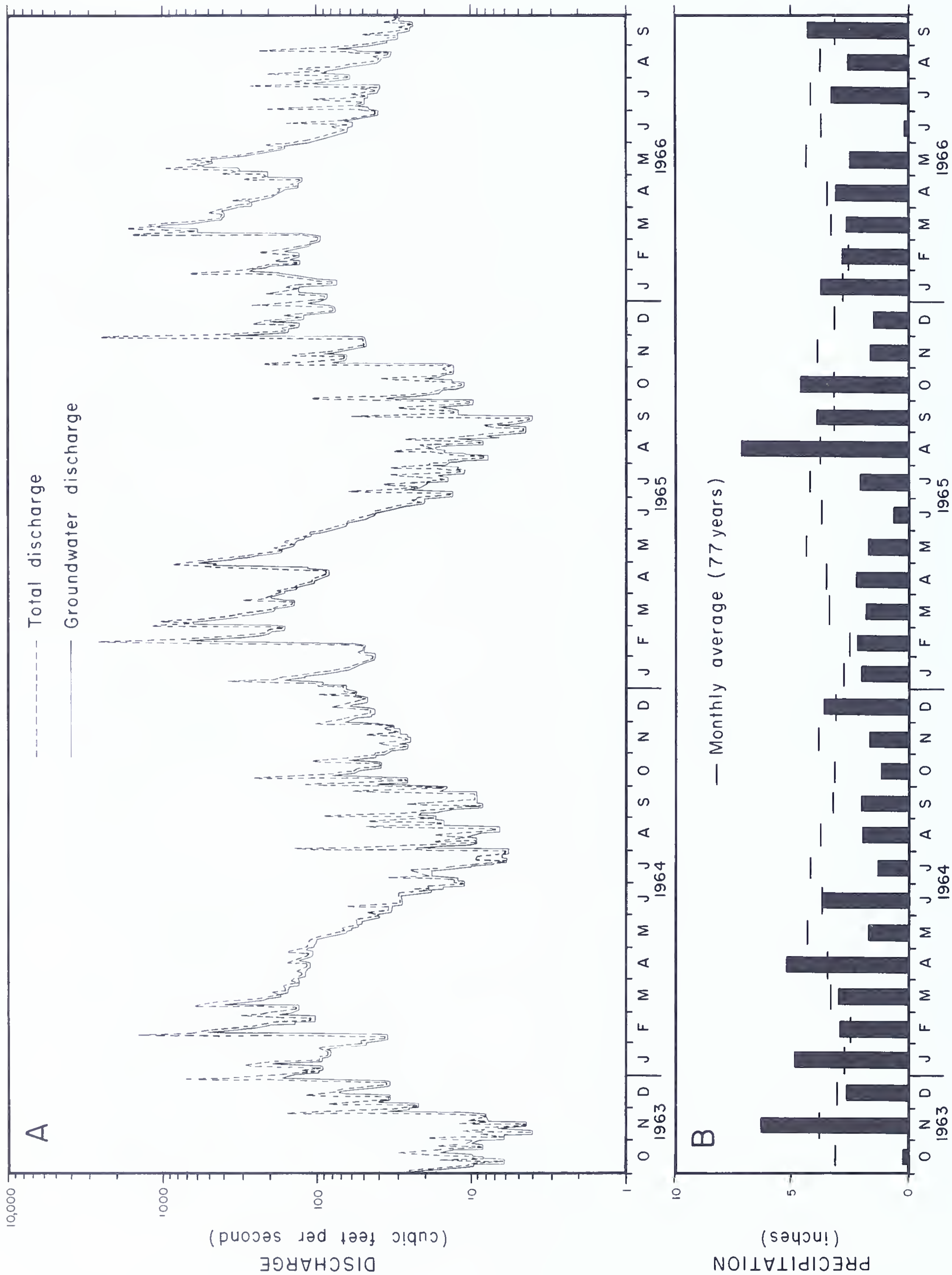


Figure 4. Hydrographs for East Mahantango Creek during a dry period, 1964–66. A, total and base-flow discharge; B, precipitation at Shamokin.

Table 4. *Water Budget for the Shamokin Creek Basin*[1]

Water year[3]	Precipitation[2] P (inches)	+	Direct runoff R_s (inches)	+	Groundwater discharge R_g (inches)	Groundwater discharge (percent of streamflow)	+	Water losses ET (inches)	Water losses (percent of precipitation)
1955	37.4		3.5		11.6	77		22.3	60
1956	49.8		3.6		19.4	84		26.8	54
1957	35.0		3.3		19.4	85		12.3	35
1958	50.0		4.4		17.5	80		28.1	56
1959	33.4		1.9		12.6	87		18.9	57
1960	55.2		3.7		20.5	85		31.0	56
1961	37.0		2.3		17.6	88		17.1	46
1962	42.7		2.4		13.5	85		26.8	63
1963	36.2		2.1		17.0	89		17.1	47
1964	35.8		3.1		14.4	82		17.9	50
1965	30.1		1.6		8.1	83		20.4	68
1966	32.8		2.0		11.9	85		18.9	58
1967	38.5		1.9		16.6	90		20.0	52
1968	40.0		2.3		17.2	89		20.5	51
1969	37.5		1.8		14.2	88		21.5	57
1970	39.5		2.6		17.9	87		19.0	48
1971	40.7		2.2		16.3	88		22.2	55
1972	55.8		7.5		27.8	79		20.5	37
1973	48.5		3.0		20.1	87		25.4	52
1974	49.5		3.0		20.9	87		25.6	52
1975	52.1		4.6		22.1	83		25.4	49
1976	40.8		2.9		21.3	88		16.6	41
1977	48.6		3.6		20.5	85		24.5	50
1978	54.6		4.4		27.2	86		23.0	42
1979	48.6		4.1		21.9	84		22.6	47
1980	35.9		2.3		18.9	89		14.9	42
1981	40.8		1.8		12.0	87		27.0	66
1982	44.9		2.4		15.7	87		26.8	60
28-year average	42.6		3.0		17.6	85		21.9	52

[1]Drainage area 54.2 square miles.
[2]Precipitation at Shamokin.
[3]October 1–September 30.

discharge accounted for 85 percent of total streamflow for the period and ranged from 77 to 90 percent of annual streamflow.

A large proportion of precipitation infiltrates to the mine tunnels and to the natural groundwater system through the disturbed land in mined areas (Ash and Link, 1953), reducing the amount of direct runoff and, conversely, increasing the groundwater discharge. Above-normal streamflow was maintained in Shamokin Creek by groundwater during the first part of a drought that began in 1980. However, groundwater discharge during 1981 maintained flow only at 67 percent of normal, because precipitation was below normal during the previous winter and spring.

Schuylkill River Basin

Anthracite-bearing formations underlie only 63 percent of the drainage area of the Schuylkill River. Much of the remainder is underlain by the Mauch Chunk Formation. High infiltration rates in the coal areas, as in the Shamokin Creek basin, cause high groundwater discharges. However, the smaller percentage of disturbed land results in a groundwater discharge that averages only 75 percent of total streamflow. Average precipitation and streamflow for the 8-year period shown in Table 5 were 50 inches and 31.6 inches, respectively. An 8-year period was used for analysis because it was the only long period of continuous record since 1953 at the gaging station.

Table 5. *Water Budget for the Schuylkill River Basin*[1]

Water year[3]	Precipitation[2] P (inches)	+	Direct runoff R_s (inches)	+	Groundwater discharge R_g (inches)	Groundwater discharge (percent of streamflow)	+	Water losses ET (inches)	Water losses (percent of precipitation)
1975	54.7		10.0		25.6	72		19.1	35
1976	48.5		6.4		23.2	78		18.9	39
1977	51.8		8.8		22.9	72		20.1	39
1978	61.1		12.3		31.3	72		17.5	29
1979	54.5		10.7		27.4	72		16.4	30
1980	39.1		5.7		23.0	80		10.4	27
1981	42.4		4.8		15.1	76		22.5	53
1982	48.0		5.6		20.1	78		22.3	47
8-year average	50.0		8.0		23.6	75		18.4	37

[1]Drainage area 133 square miles.
[2]Average precipitation at Shamokin and Tamaqua.
[3]October 1–September 30.

Flow during the drought year of 1980 was sustained at above-average levels by groundwater discharge, although direct runoff was below average. During 1981, the second year of drought, groundwater discharge was 36 percent below average because precipitation during the previous winter and spring was below normal, although precipitation was greater than in 1980.

The three stream basins analyzed responded to drought conditions similarly, despite certain physical differences. For example, below-average precipitation in 1980 affected direct runoff but did not have a major impact on total streamflow. However, below-normal precipitation and, therefore, recharge in the winter and spring of 1981 had a major impact on streamflow because groundwater discharges were greatly reduced. The impact was less on the basins draining rocks disturbed by mining because of higher infiltration rates and greater storage capacity.

The average annual groundwater discharge is one measure of the groundwater resource available; it provides a gage or standard to estimate the limits of groundwater development in a basin or aquifer. Table 6 shows the average groundwater yield per unit of land surface for the Mauch Chunk and Llewellyn aquifers, based on groundwater discharges from the East Mahantango Creek and Shamokin Creek basins.

In summary, groundwater is available to provide needed supplies during drought periods. The groundwater resource is seriously affected only by a lack of winter and spring recharge. Even during periods of drought lasting several years, such as in the early 1960's, discharges indicate an ample supply of groundwater.

Table 6. *Aquifer Yields Estimated from Groundwater Discharge to Streams*

Yield [(gal/min)/mi²]	Mauch Chunk Formation	Llewellyn Formation
Minimum (driest year)	170	270
Average	370	580
Maximum (wettest year)	590	920
3-year wet cycle	480	750
3-year dry cycle	250	380
1980	410	620
1981	200	400

GROUNDWATER-FLOW SYSTEMS

Groundwater-flow systems grade from confined to unconfined. Confined systems that have flowing wells occur in valleys underlain by the Mauch Chunk Formation near the nose of major plunging synclines, and in the Pottsville Formation along the north flank of the Minersville synclinorium and east of Mount Carmel (Figure 5). High-yield wells have been developed in these areas.

The groundwater-flow system is chiefly controlled by the ridge and valley topography created by the folding of rocks of contrasting resistance to erosion. No regional groundwater system exists, but rather many local systems are present that range in size from less than 1 square mile to several tens of square miles and may grade from flowing to nonflowing

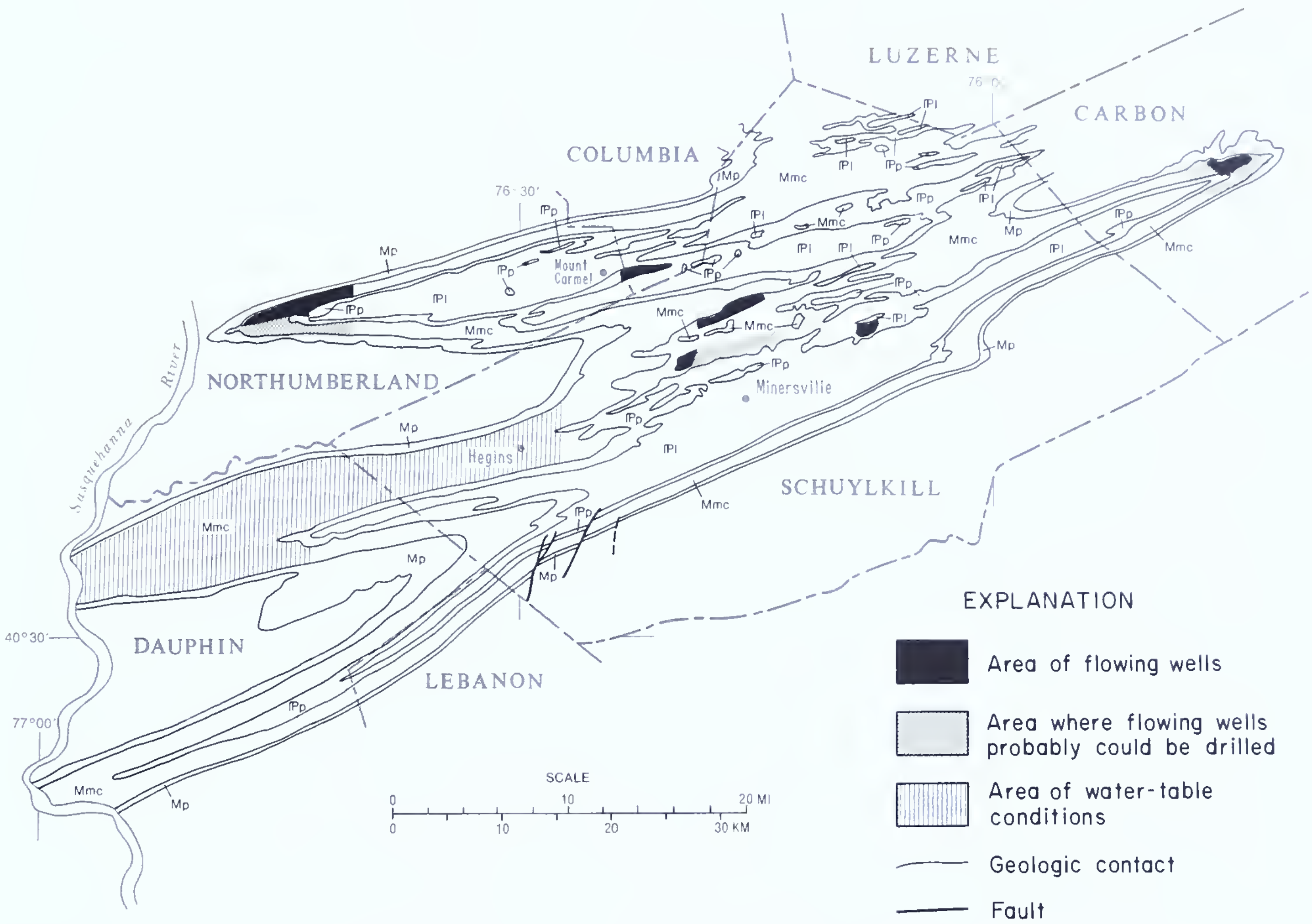


Figure 5. Areas that have flowing wells and areas under general water-table conditions. IPl, Llewellyn Formation; IPp, Pottsville Formation; Mmc, Mauch Chunk Formation; Mp, Pocono Formation.

conditions, depending on local relief and structure. Within the Llewellyn Formation, where deep mining has been extensive, the natural system has been greatly changed. Here, numerous shafts and tunnels have drastically increased permeability. Groundwater movement, direction, and water levels are now controlled largely by these openings. Intermine movements are discussed in Growitz and others (1985). Although a complete description of each groundwater basin is beyond the scope of this study, the following discussion and diagrams illustrate the major types of flow and conditions that exist in the Pottsville and Mauch Chunk Formations. From about the vicinity of Hegins westward to the Susquehanna River (Figure 5), the broad valley underlain by the Mauch Chunk is chiefly a water-table system in fractured rock, with lateral flow toward surface streams. Only on the flanks of the ridges formed by the Pocono and Pottsville Formations are water movements likely to have a downward component.

Figure 6 shows the general flow of groundwater in rocks near the nose of a plunging syncline, such as at Jim Thorpe on the eastern end of the Southern Anthracite field. Water moves along bedding surfaces toward the axis and down the plunge of the syncline and discharges through springs into the mid-valley stream. Upward movement near the center of the syncline probably occurs through joints parallel to the fold axis. Deep wells near the center of the synclinal valley, such as well A, intercept zones of water under pressure derived from head differences between the ridge and valley, and flow at high rates. Well B intercepts the Pocono Formation under unconfined conditions, but only in the adjacent groundwater basin. Beneath this well, water may move down the dip within the synclinal basin. Well C intercepts the Pocono, but only on the flank of the ridge, where head differences are great enough to produce flow. Yields are low, however, and the water may contain elevated iron concentrations.

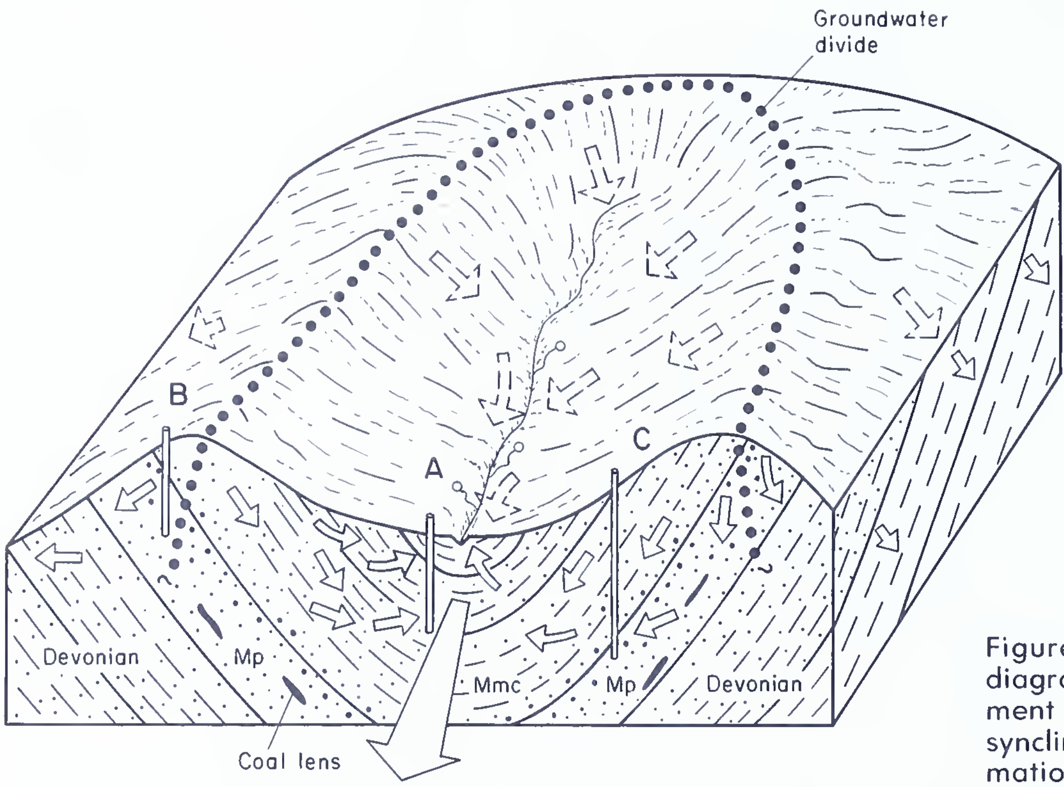


Figure 6. Generalized block diagram of groundwater movement through rocks of a plunging syncline. Mmc, Mauch Chunk Formation; Mp, Pocono Formation.

Figure 7 shows general conditions on the flank of a syncline in the Mauch Chunk Formation. The flowing well D is under conditions similar to those in well C in Figure 6. Water moves chiefly along strike or downdip and, therefore, is not likely to be contaminated by mine discharges from the Llewellyn or Pottsville Formations. Flow on the downdip side of the valley is largely confined to the shallower weathered rock and overburden, and movement here is toward the center of the valley. Groundwater flow downdip under the ridge is prevented by extremely low permeability at depths of several thousand feet. Flowing wells analogous to well D are located at Trevorton, just north of the Western Middle Anthracite field. These wells are about 7 miles east of the nose of a plunging syncline. Flowing wells also are present near the nose. Water levels are gradationally lower to the east and are just below land surface about 1 mile east of the Trevorton wells.

Figure 8 shows general groundwater flow in an anticlinal valley underlain by the Mauch Chunk Formation in conditions that are similar to those between Frackville and Lavelle (Plate 1). Here, shallow groundwater moves toward the valley from adjacent ridges. Rising water levels observed in some wells along the lower ridge slopes more than 3 days after rainfall suggest that recharge from drainage off the adjacent ridges continues long after direct runoff has left the basin. Perennial flow from a line of springs and a shallow well (well E) on the ridge flank may be controlled by a thrust fault. In the valley, water moves parallel to the fold axis (toward the reader) along joints and bedding surfaces. Water levels in wells under the mid-valley hill (well F) are deep and only slightly higher than those in adjacent streams in both spring and fall, suggesting a zone of high permeability. The highest yielding wells (Sc-156 and Sc-347) in the valley are here.

Although the Pottsville Formation commonly forms a narrow ridge between adjacent valleys underlain by the Llewellyn and Mauch Chunk Formations, some high plateaus in the central part of the area are underlain by gently folded and shallow-dipping rocks of the Pottsville Formation. Attempts have been made to develop groundwater supplies for public systems from wells in these rocks. These efforts have yielded flowing wells that produce several hundred gallons per minute, but the water contains 3 to 7 mg/L of iron.

A two-well field near Glendower (Figure 9) was studied using borehole geophysical probes and an inflatable packer. The well highest in elevation, Sc-321, flowed until the lower well (Sc-322) was drilled and began flowing. Water levels in well Sc-321 fluctuated between about 6 and 18 feet below land surface during the period that the well was monitored by the U.S. Geological Survey.

The hydrograph for well Sc-321 (Figure 10) indicates interactions between two flow systems, one confined and one shallow semiconfined. The sys-

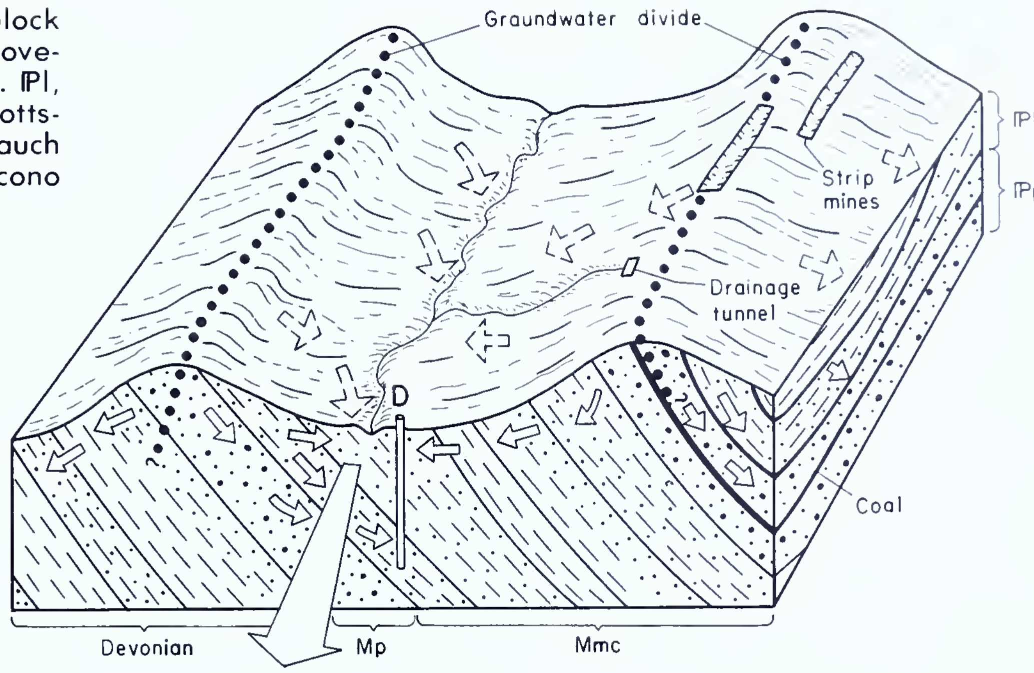


Figure 7. Generalized block diagram of groundwater movement on the flank of a fold. IPl, Llewellyn Formation; IPp, Pottsville Formation; Mmc, Mauch Chunk Formation; Mp, Pocono Formation.

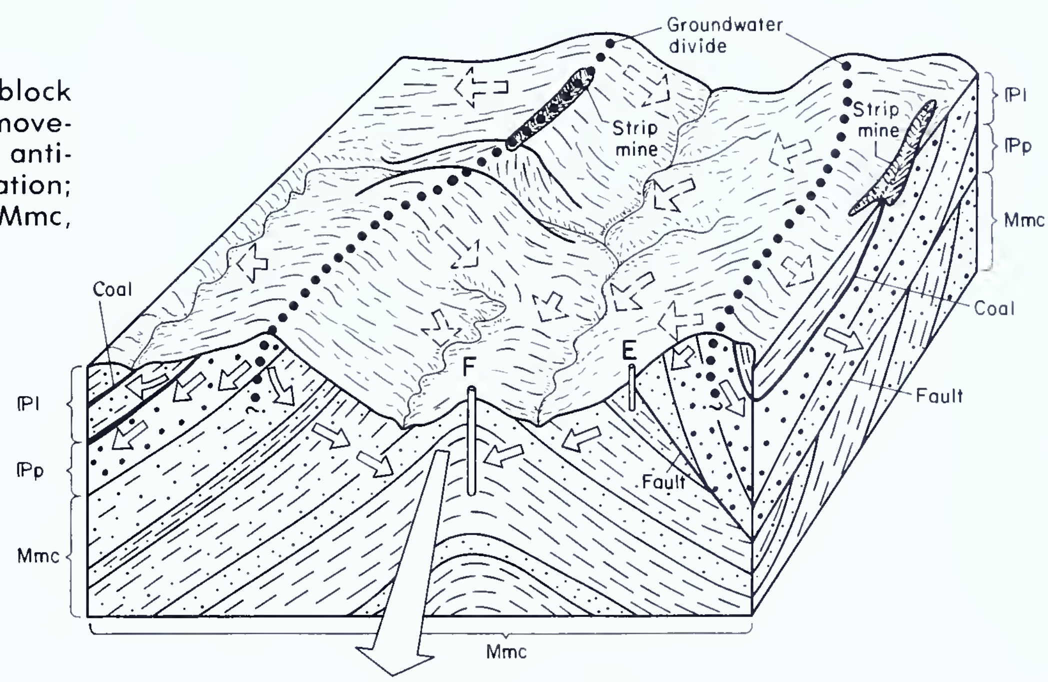
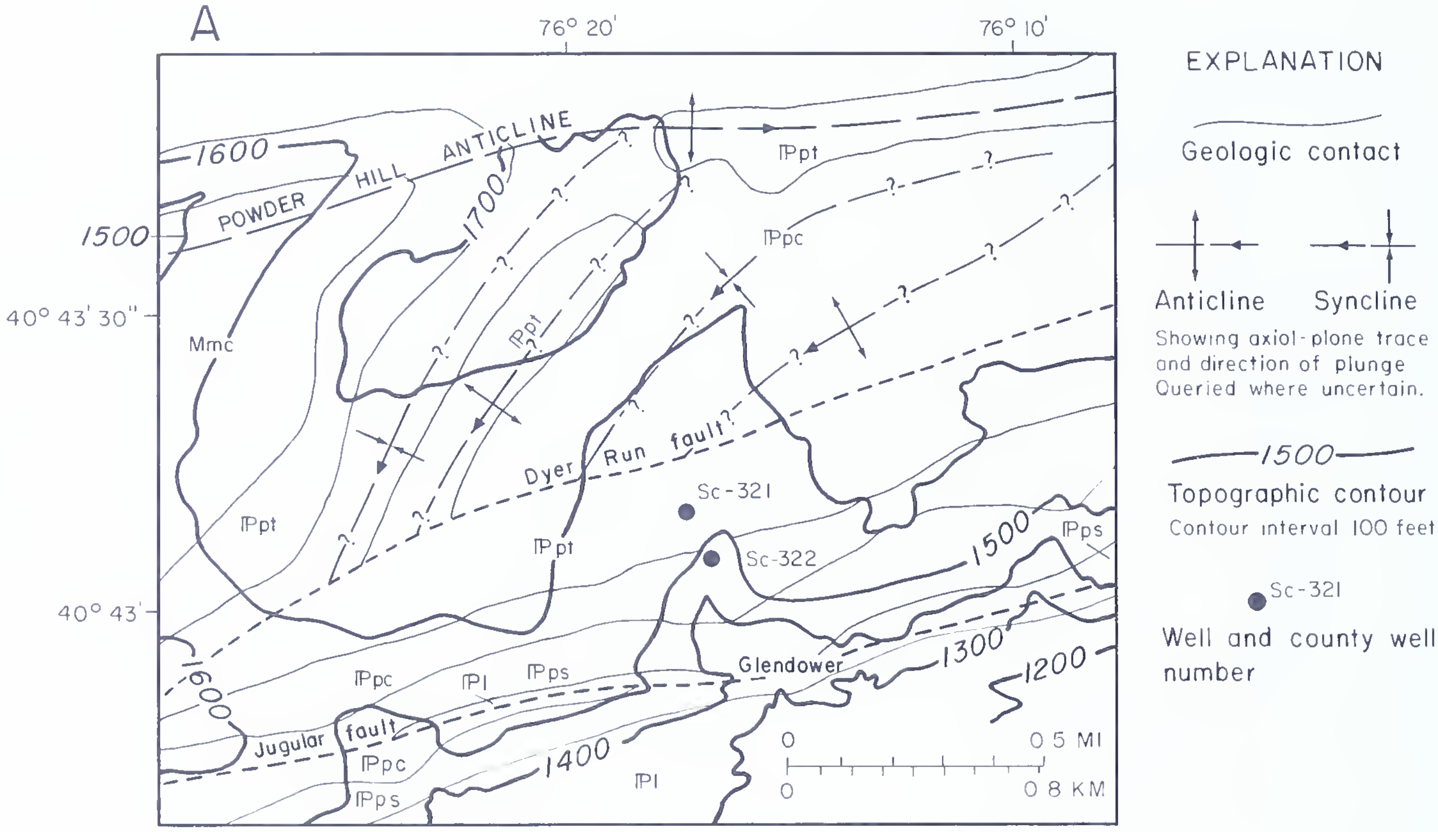


Figure 8. Generalized block diagram of groundwater movement through rocks of an anticline. IPl, Llewellyn Formation; IPp, Pottsville Formation; Mmc, Mauch Chunk Formation.

tems are connected chiefly by the well bores, probably along the bedding surface intercepted at altitudes of 1,440 and 900 feet in wells Sc–321 and Sc–322, respectively, and develop maximum observed head differences of about 10 feet. The continuous record of water levels for well Sc–321 shows a diurnal fluctuation (Figure 10) but no direct response to precipitation—only a gradual rise and fall over extended wet and dry periods when the total head is between about 9 and 18 feet. This condition existed from July 1981 through July 1982 and indicates that the water level was controlled by the confined system. After a period of erratic fluctuations, which followed an abrupt rise of about 3 feet in July 1982, the water level stayed in the range of 6 to 8.5 feet until data collection ended in May 1983. During this period, the hydrograph shows direct sluggish response to precipitation and a slight diurnal fluctuation of water level and indicates that the shallow semiconfined system controlled water level. The effects of the borehole connection between the two flow systems can be seen on the hydrograph for the last half of July 1981. The water level in well Sc–321 came to within 1 foot of land surface after the lower well was sealed for 1 day. The pressure head in well Sc–322 reached 39 feet above land surface on July 15. On release



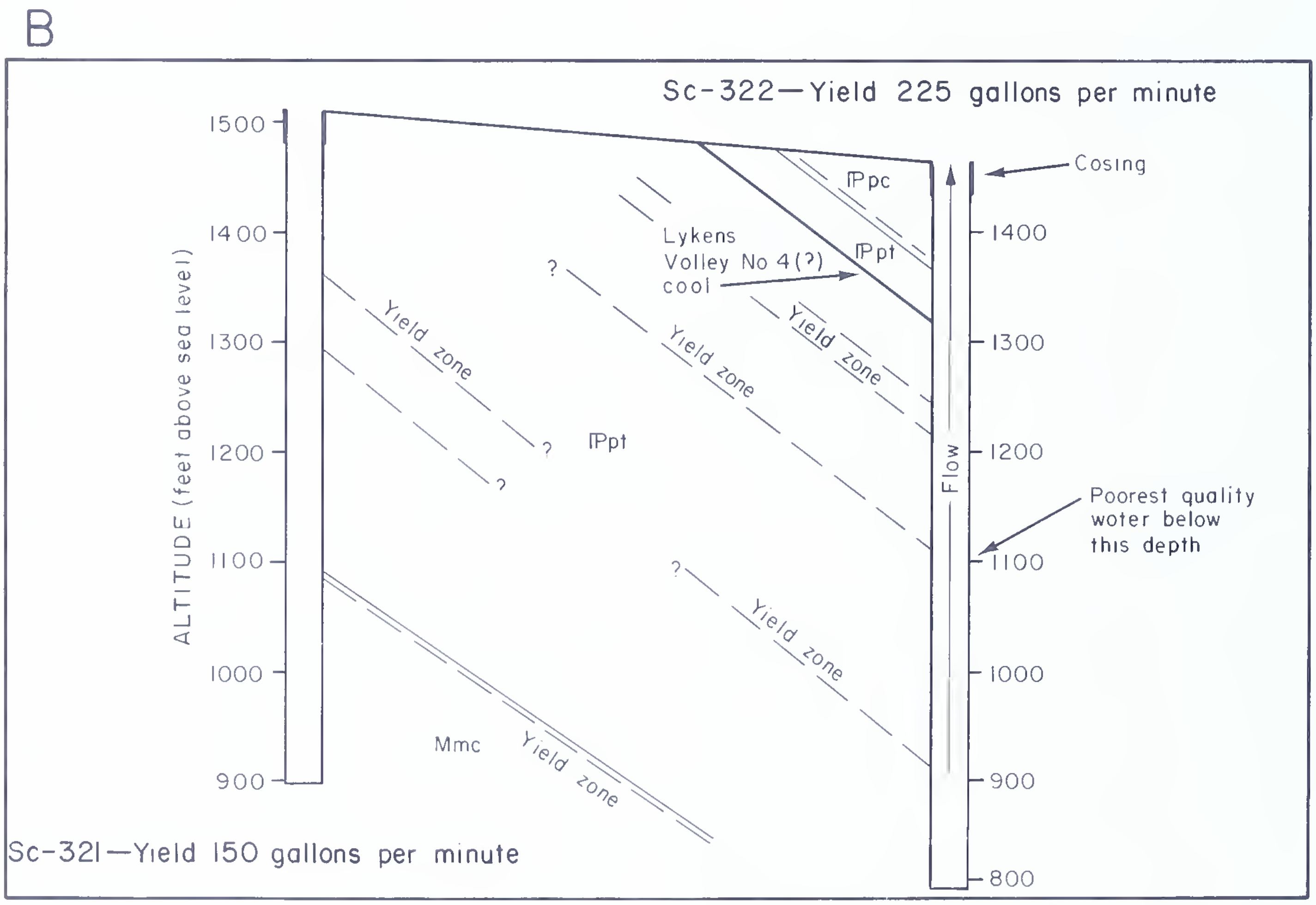


Figure 9. Geologic map (A) and hydrogeologic cross section (B) of the Glendower well field. IPl, Llewellyn Formation; IPps, Sharp Mountain Member of Pottsville Formation; IPpc, Schuylkill Member of Pottsville Formation; IPpt, Tumbling Run Member of Pottsville Formation; Mmc, Mauch Chunk Formation. Geology slightly modified from Wood and others (1968).

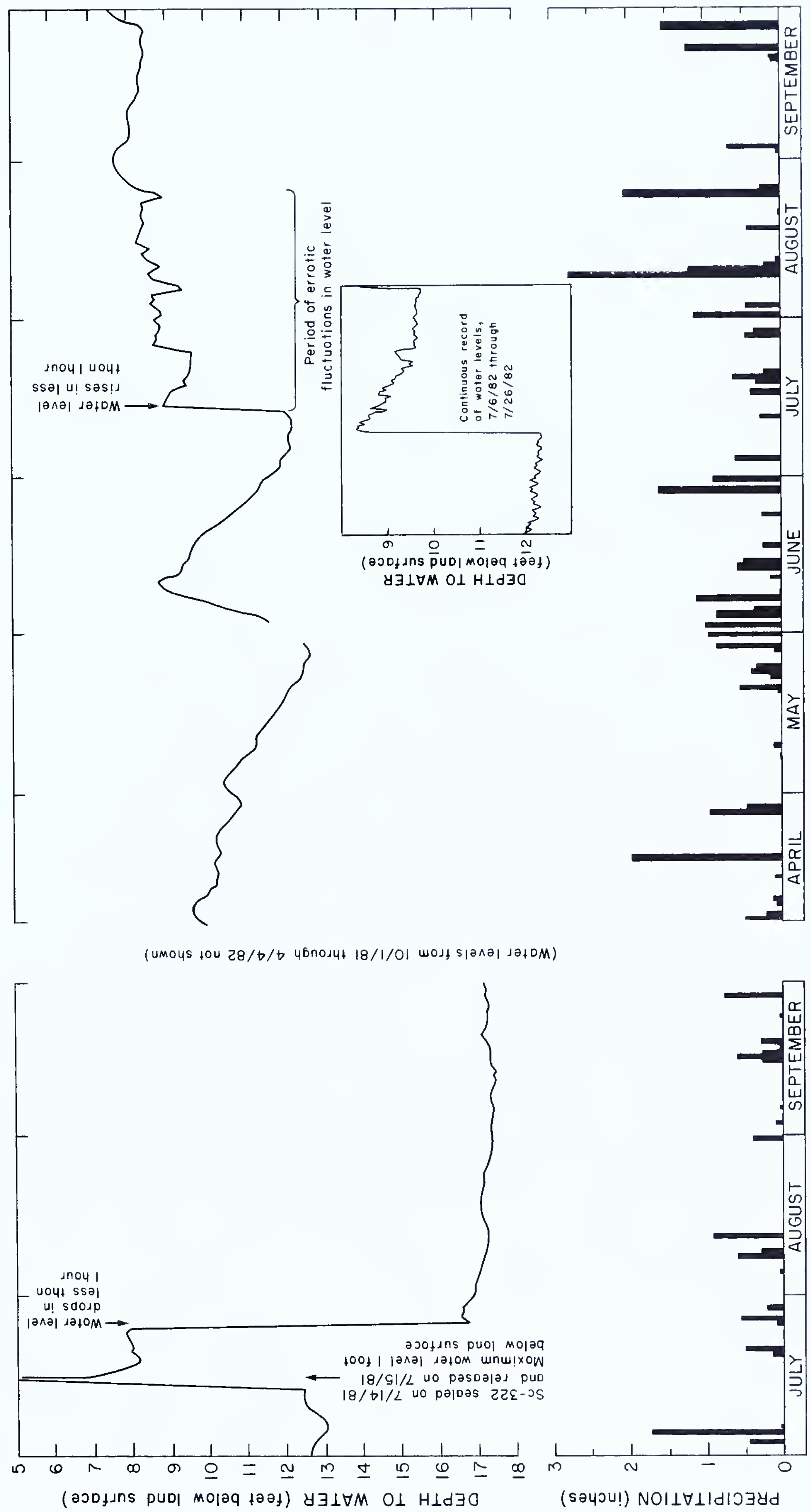


Figure 10. Hydrograph of daily low water levels for well Sc–321 near Glendower and precipitation at Mahanoy City.

of the packer, the hydrograph for well Sc–321 first shows a normal recession but then erratic fluctuations for 8 days at a level that is about 5 feet higher than the level that existed before the lower well was sealed. The level subsequently dropped about 8 feet in less than 1 hour, and the erratic fluctuations ceased. Sealing the lower well apparently allowed the head to build up in the confined system until water "spilled over" through the borehole of well Sc–321 into the shallow system. Eight days after unsealing the well, the water transferred to the shallow system had drained, and the level in the system dropped below the access opening to well Sc–321. Then, the lower head in the confined aquifer rapidly reestablished control of water level in the well.

WATER-YIELDING PROPERTIES OF THE ROCK UNITS

Rocks that supply usable quantities of water to wells and springs are called aquifers. Water occurs chiefly in openings in the aquifer created by breaks in the consolidated-rock mass. These breaks may be joints, faults, or separations between beds. Any type of opening may be enlarged by the solution action of water on the cement between rock grains. Chemical weathering is limited by the impermeability of the rock mass and the resistance of siliceous cements and grains to the weak acids present in the water. The size, distribution, and degree of interconnections of openings determine the ability of the aquifer to store and transmit water and, therefore, the yield of wells. A well must intercept at least one saturated opening or water-bearing zone to obtain water. Wells commonly intercept more than one water-bearing zone, and as many as 17 were reported in the area of investigation.

WATER-BEARING ZONES

Figure 11 is a summary of the data on water-bearing zones reported for wells in the "Record of Selected Wells" (Table 16). The data available for wells in the Pocono Formation are insufficient for analysis. Data for the upper 50 feet do not include openings above the static water level in the wells. Both the number of zones and the ratio of water-bearing zones to the footage of hole drilled decrease with depth. Although this suggests a decreasing yield potential as well depth increases, significant amounts of water are encountered at depths of up to 500 feet in favorable locations. Below 500 feet, only three openings were reported: one at 548 feet in the Mauch

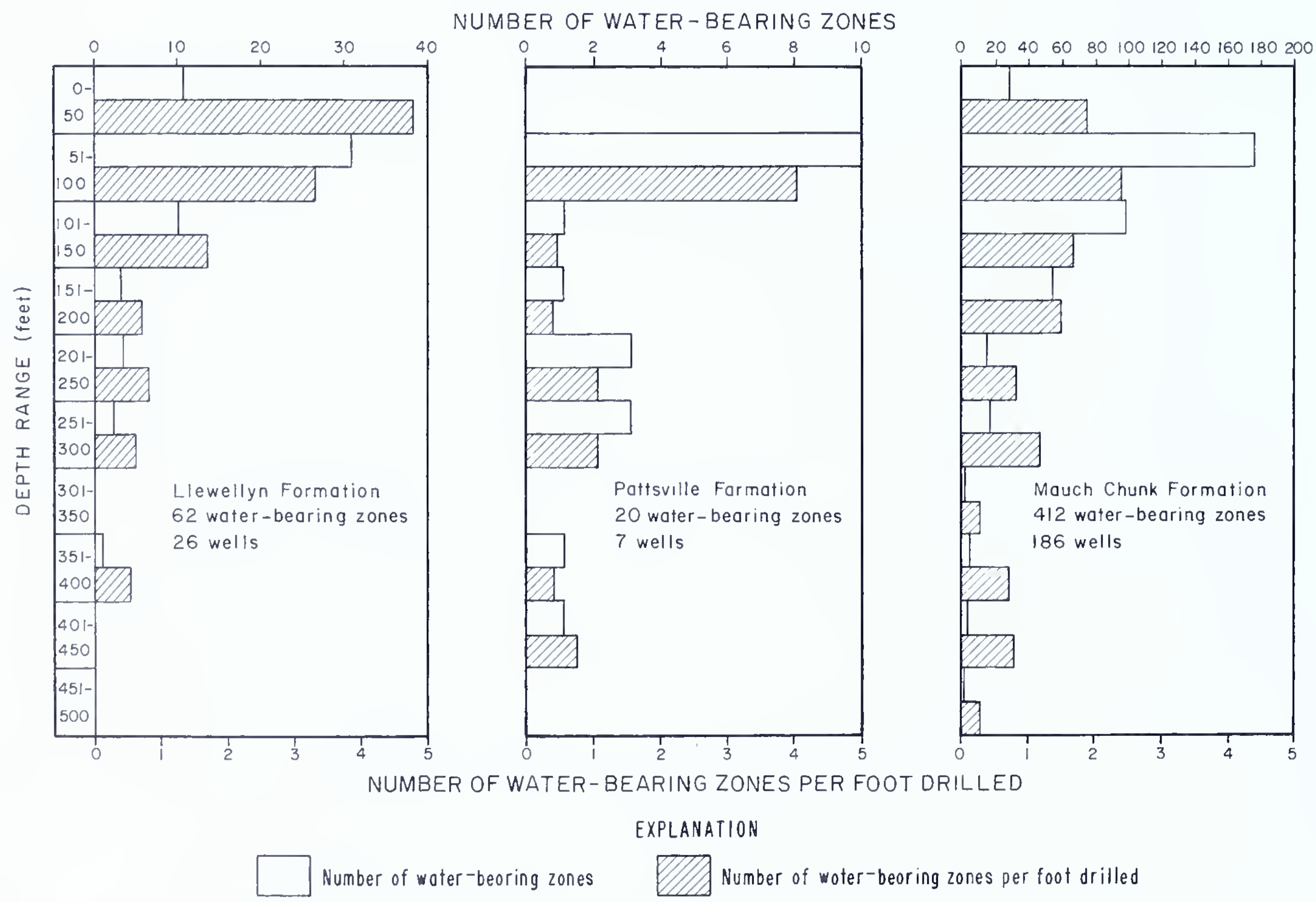


Figure 11. Distribution of water-bearing zones intercepted by wells.

Chunk, one at 552 feet in the Pottsville, and one at 870 feet in the Llewellyn.

Wells intended for single-dwelling use should be drilled about 200 feet to adequately test the site if sufficient amounts of water have not been developed at shallower depths. If some water has been obtained, deeper drilling will provide a storage reserve in the borehole, even if no additional water-bearing zones are penetrated. Wells that penetrate water-bearing zones only at shallow depths are vulnerable to drought if water levels fall below the water-bearing zones.

WELL CHARACTERISTICS

Statistics on other depth characteristics of wells in the formations are shown in Table 7. Wells in the Pottsville Formation are much deeper than those in other formations, largely because all but one of the wells were intended for nondomestic use. In order to obtain the maximum potential yield, such wells are drilled deep to intercept as many yield zones as possible. The contrast between the depths of domestic and nondomestic wells in other geologic units is due to the same reason.

The amount of casing in wells is nearly the same in all units, suggesting similar amounts of overburden everywhere. Shallower depths to water in the deeper, nondomestic wells imply that, in general, higher heads are obtained from deeper water-bearing zones. Therefore, upward movement chiefly on the lower slopes of major valleys adjacent to ridges prevails. The reversal of this relationship for water levels in the middle member of the Mauch Chunk Formation is attributed to the central position of this member in the valley. Here, although wells are deeper, water-bearing zones that could be fed by the adjacent ridges are not developed. The altitudes of well tops reflect the relative topographic positions of geologic units with the exception of the Pocono Formation, for which insufficient altitude data are available. Nondomestic wells that tap the middle member of the Mauch Chunk are lower in altitude than domestic wells because most of the nondomestic wells are in valleys in the southern part of the area that have lower altitudes.

Data on the distribution of water-bearing zones and statistics on other well characteristics are useful in planning the specifications of wells and for making decisions during drilling operations (such as whether to deepen a well in search of additional water). For example, the depth of a high-yield well in the undifferentiated Mauch Chunk Formation might be planned for 200 feet, the depth below which the number of water-bearing zones decreases sharply. If the quantities of water obtained to that depth were only marginally adequate, it might be more practical to deepen the well to 300 feet rather than to drill another well. Below 300 feet, the number of water-bearing zones again decreases sharply.

SPECIFIC CAPACITY AND WELL YIELDS

Wells vary greatly in their ability to yield water because of variability in the distribution and size of water-bearing zones within and between geologic units. Selected pumping tests of about 1-hour duration reported by consultants, drillers, and U.S. Geological Survey personnel for 215 wells were used to evaluate the water-yielding ability of the geologic units. The results of these tests (specific capacity) are listed in the "Record of Selected Wells" (Table 16). Figure 12 shows how a pumping test is done and how the specific capacity is calculated. The maximum rate of pumping possible in real wells varies with seasonal changes in water level and depends more on the depth to water-bearing zones for available drawdown than on well depth.

Statistics on specific capacity can be used to compare the yielding ability of rock formations as well as other factors that affect yield. The statistical summary in Table 8 shows both specific capacity and reported yields of wells for each geologic unit grouped by two general magnitudes of water demand—small (domestic and commercial) and large (all other uses). Members of geologic formations were evaluated, where possible, because many geologic quadrangle maps show them, although they are not shown on Plate 1. Statistics on small withdrawals are not reported for the Pottsville and Pocono Formations because data were available for only one domestic well in each formation. No statistics are given for the lower member of the Mauch Chunk because data were available for only one well. Sufficient data for making comparisons between wells drilled for small and large production were available only for the Mauch Chunk Formation. The median specific capacity of large-demand wells is 3.5 to 8 times that of small-demand wells. A similar relationship is shown for reported yields. Data on large-demand wells indicate the range of maximum yields that can be expected from wells sited using geologic knowledge and groundwater experience. Cumulative-frequency plots of these data show that the undifferentiated Mauch Chunk Formation is the highest yielding rock unit. Figure 13 shows only reported yield data, because reliable yield data were more abundant than specific-capacity data.

Table 7. *Summary of Well Construction Characteristics*

Geologic unit	Well depth (feet)				Depth of casing (feet)				Depth of water (feet)				Altitude of well (feet above sea level)				Well uses[2]
	No. of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	No. of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	No. of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	No. of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	
Llewellyn Formation	24	86	122	247	23	38	42	51	20	6	23	44	24	800	850	927	D, C, N
	6	150	306	482	3	30	42	56	4	13	18	110	6	742	890	1,335	P, I
Pottsville Formation																	
Undifferentiated[3]	11	383	500	580	5	30	40	50	8	14	19	99	11	1,495	1,600	1,720	N, P, I
All units[4]	17	190	400	535	7	30	41	45	12	16	24	38	17	1,515	1,677	1,720	All
Mauch Chunk Formation																	
Undifferentiated	69	121	155	200	66	30	42	50	63	30	40	56	69	542	620	707	D, C, N
	43	242	300	413	29	29	40	56	28	8	16	45	42	740	1,065	1,452	P, I
Upper member	8	131	202	272	6	33	37	41	8	18	38	60	8	954	1,265	1,571	D, C, N
	13	190	205	490	8	33	47	73	6	15	22	37	13	1,295	1,490	1,615	P, I
Middle member	103	102	130	200	92	35	41	54	96	25	40	54	103	890	1,022	1,120	D, C, N
	14	172	278	500	9	33	43	66	13	11	43	55	15	760	910	1,040	N, P, I
Pocono Formation	3	101	247	814	2	—	51	—	3	0	35	80	3	680	740	1,100	All

[1]Percentage of wells that have values less than or equal to the value shown.
[2]D, domestic; C, commercial; I, institutional; N, industrial; P, public supply.
[3]Pottsville mapped as one unit (not subdivided into members).
[4]Pottsville mapped as separate members; data are for all members combined.

A = **Depth to static water level, in feet**
B = **Depth to pumping water level, in feet**
Drawdown = **B − A**
C = **Maximum possible drawdown, in feet**
Q = **Yield, in gallons per minute (gal/min)**

$$\textbf{Specific capacity} = \frac{\text{Yield}}{\text{Drawdown}} = \frac{Q}{B-A}$$

For example: Water stands 62 feet below the surface before a well is pumped (A = 62 feet). The pump is run for an hour and is measured by filling a 55-gallon drum in 10 minutes ($Q = \frac{55}{10} = 5.5$ gal/min). The water level is then found to be 73 feet below the surface of the ground (B = 73 feet). The drawdown is then $73 - 62 = 11$ feet, and the specific capacity is $\frac{5.5}{11} = 0.5$ gallon per minute per foot of drawdown. If the well is 100 feet deep, the maximum possible drawdown (C) is $100 - 62 = 38$ feet. Therefore, the maximum rate at which the well could ever be pumped is $0.5 \frac{\text{gal/min}}{\text{feet}} \times 38 \text{ feet} = 19$ gal/min.

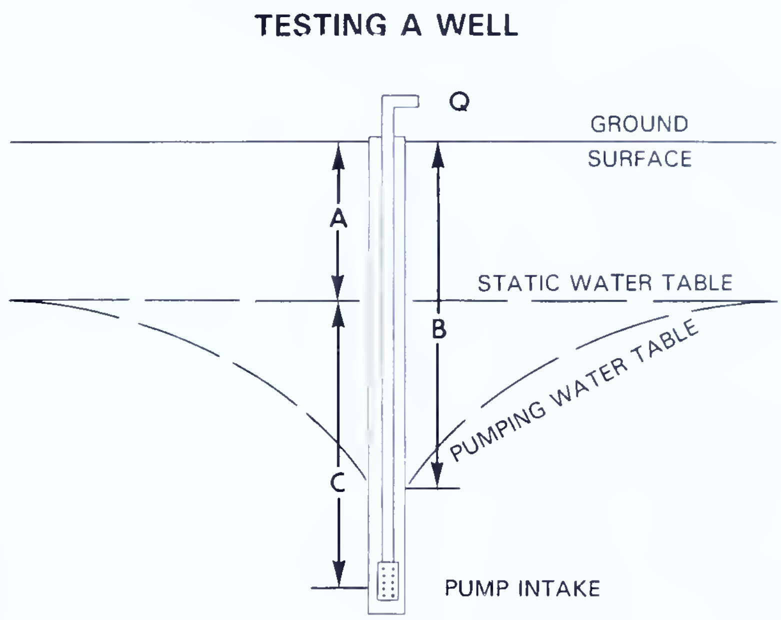


Figure 12. Diagram showing how specific capacity is determined from a pumping test (modified from Landers, 1976, p. 37).

Table 8. *Summary of Water-Yielding Ability of Wells*

Geologic unit	Specific capacity [(gal/min)/ft] Number of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	Reported yield (gal/min) Number of wells	Percent[1] 25	Percent[1] 50 (median)	Percent[1] 75	Well uses[2]
Llewellyn Formation	19	0.09	0.34	0.71	24	9	18	24	D, C
	2	—	[3].25	—	6	10	24	59	N, P, I
Pottsville Formation									
Undifferentiated[4]	4	.14	3.3	11	11	21	75	125	N, P, I
All units[5]	6	.26	.46	7.9	14	10	30	113	All
Mauch Chunk Formation									
Undifferentiated	57	.08	.15	.24	69	10	15	20	D, C
	28	.54	1.2	2.7	43	60	100	225	N, P, I
Upper member	6	.03	.18	4.7	8	5	6	40	D, C
	6	.15	.62	2.6	13	20	35	115	N, P, I
Middle member	80	.13	.30	.54	103	11	20	30	D, C
	9	.50	1.2	3.0	15	40	70	110	N, P, I
Pocono Formation	2	—	[3].47	—	2	—	[3]15	—	D, N

[1]Percentage of wells that have values less than or equal to the value shown.
[2]C, commercial; D, domestic; I, institutional; N, industrial; P, public supply.
[3]Insufficient data.
[4]Pottsville mapped as one unit (not subdivided into members).
[5]Pottsville mapped as separate members; data are for all members combined.

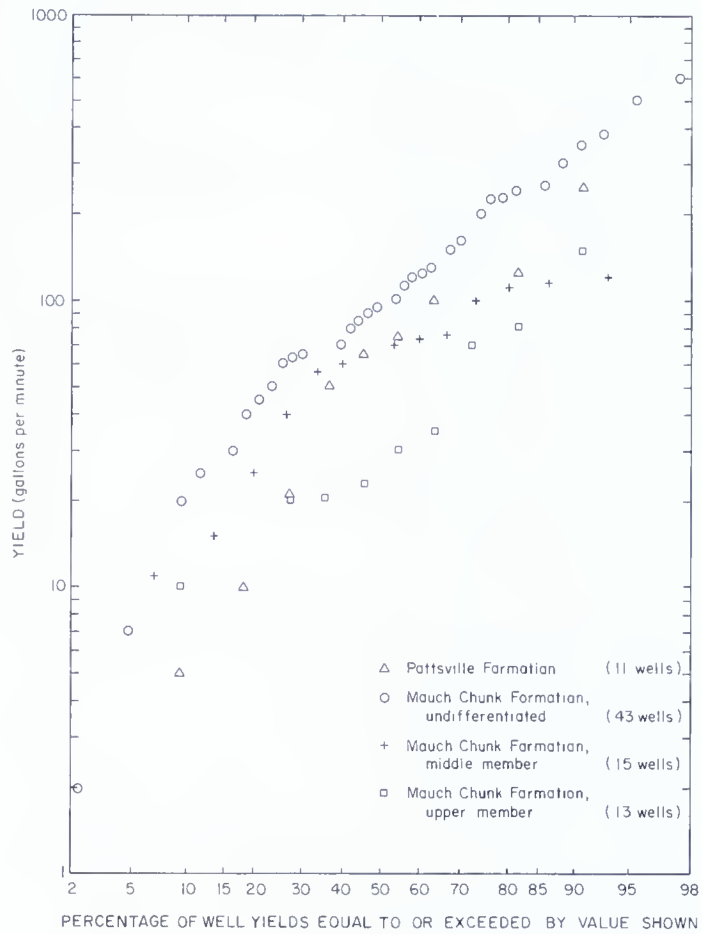


Figure 13. Cumulative-frequency distribution of reported yields for large-capacity wells.

WELL SPACING AND INTERFERENCE

Competition for the same water occurs when wells are spaced too closely. Interference is the result of overlap of drawdowns and reduces the yield of any well within the area influenced by pumping from another well. The distribution of drawdown in the area influenced by a pumping well is determined by the stratigraphy, geologic structure, and hydraulic properties of the rocks. Variability in geologic structure and hydraulic properties encountered precludes all but generalizations about interference and well spacing in the aquifers, as illustrated in the following descriptions of conditions at several sites.

At a distance of 1,300 feet from the pumping well (Nu–163) along the strike of bedding in the confined groundwater system of the Mauch Chunk Formation at Trevorton, water levels declined about 26 feet in 48 hours when the well was pumped at a rate of 235 gal/min. Across strike at a distance of 300 feet, the decline was about 17 feet. Therefore, the hydraulic properties of the aquifer are anisotropic; drawdowns along strike are about five times greater than those across strike.

Pumping tests on two other well fields in the Mauch Chunk Formation, one at Jim Thorpe in Carbon County and the other outside the study area near Zion Grove in northeast Schuylkill County, also indicated anisotropic conditions.

Wells Sc–332 and Sc–333 in the Pottsville Formation, 425 feet apart and approximately along strike (Figure 14), showed mutual interference when they were pumped simultaneously. Figure 14 is a plot of drawdown in both wells during a pump test. The inset on Figure 14 is a cross-sectional diagram through both wells showing the effects of interference encountered during pumping.

The effects of interference likely to be encountered elsewhere in the Mauch Chunk and Pottsville Formations probably will depend on local conditions. However, it is likely that large-production wells spaced less than 1,500 feet from each other along strike will show significant interference based on the Trevorton pumping test.

QUALITY OF GROUNDWATER

The chemical quality of groundwater is governed chiefly by chemical constituents in precipitation, by chemical reactions with mineral matter in the soil and rock through which the water passes, and by the length of time the water has been in contact with these materials. Small quantities of dissolved minerals are obtained from the atmosphere during precipitation. Human activities such as the discharge of sewage, the use of fertilizers, herbicides, and insecticides on agricultural and residential land, and the burial of refuse may greatly affect the kind and amount of dissolved chemicals in groundwater.

Of all of man's activities in the Anthracite region, coal mining has had the most profound effect on groundwater quality in the Llewellyn Formation (Biesecker and others, 1968, p. 73). These effects are well known and may include a pH below 4.5 and high dissolved solids, iron, manganese, and sulfate. The exposure of large amounts of pyrite (iron sulfide, FeS_2) to water, oxygen, and certain types of bacteria by the mining process increases the amount of mineral solution well above levels produced under natural conditions.

FIELD MEASUREMENTS

Field determinations of specific conductance, hardness, pH, and total iron are listed in Table 16. The minimum groundwater temperature observed was 10°C in the Pottsville Formation and in all mem-

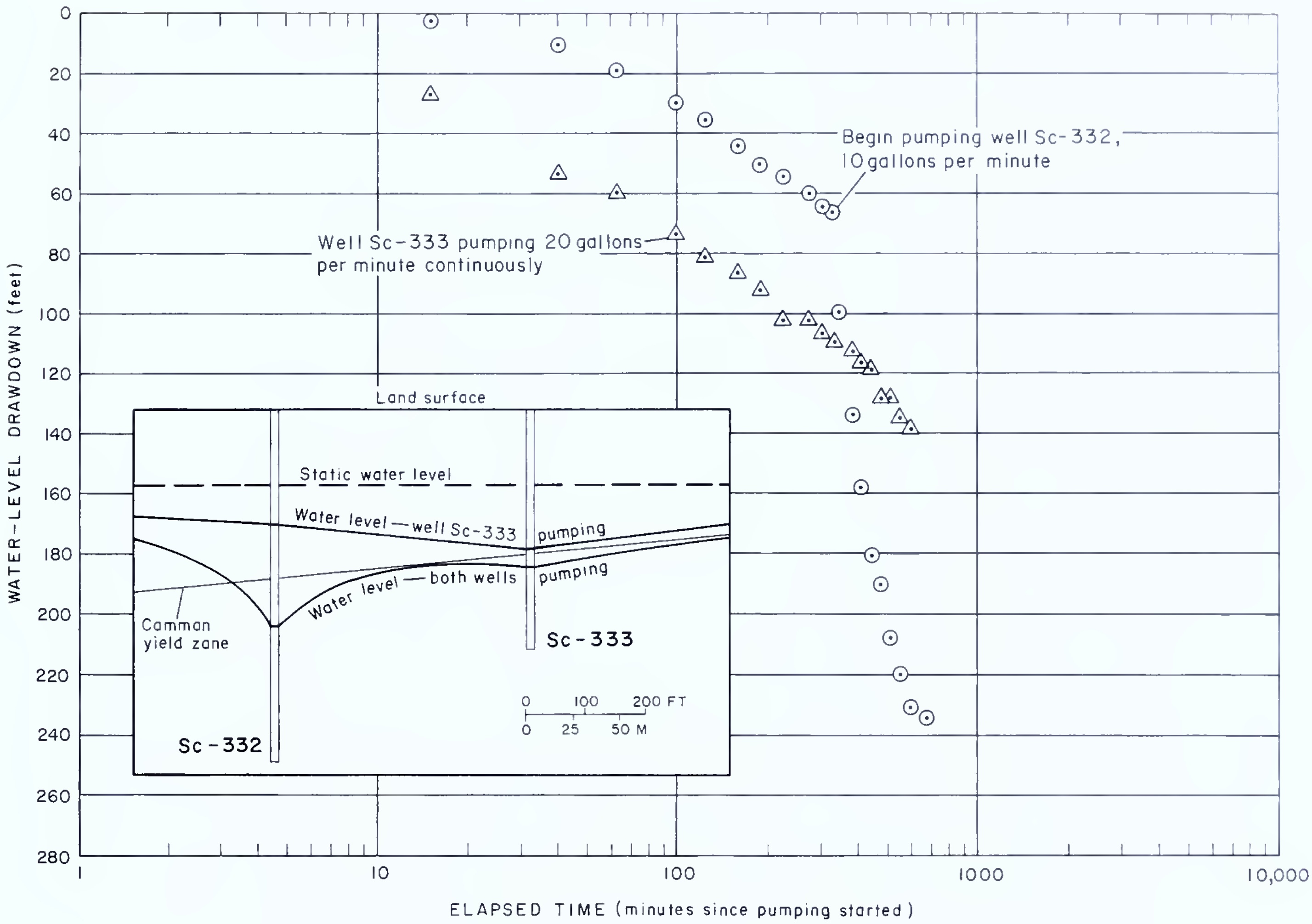


Figure 14. Interference between wells Sc–332 and Sc–333 drawing water from a common yield zone.

bers of the Mauch Chunk Formation, and 11 °C in the Llewellyn Formation. Groundwater temperature approximates the mean annual air temperature for the area. Higher well water temperatures at the tap usually are due to heating in the pumping and distribution system before measurement. Exothermal chemical reactions between exposed minerals and water may be responsible for the higher water temperatures in the Llewellyn Formation. Data on temperature of water from the Pocono Formation were not available. The water temperature relative to high and low air temperatures in summer and winter, respectively, and small annual variability in temperature make groundwater an excellent cooling and heating agent.

A summary of field measurements of unfiltered water samples for values of specific conductance, hardness, pH, and total iron by geologic unit is shown in Table 9. Water from all units contains low to moderate amounts of dissolved constituents, based on the specific conductance, and is soft to moderately hard. The pH of samples from all geologic units ranges from moderately acidic to slightly alkaline. The median value of iron determined in the field using colorimetric methods for water from all geologic units except for the middle member of the Mauch Chunk Formation exceeds the U.S. Environmental Protection Agency drinking water standard of 0.3 mg/L. Iron and small amounts of hydrogen sulfide (H_2S) gas that commonly accompany the iron are not harmful to health but do impart unpleasant taste and odor to the water and can stain items such as clothing and porcelain.

CHEMICAL ANALYSES

Ninety-two laboratory analyses of the major chemical constituents in water from 83 wells and 3 springs are reported in Table 15. Thirty of the analyses are from earlier studies and the remainder from the current study. Results of the analyses are summarized in Table 10 as the median and range of chemical constituents determined for each geologic unit. Statistics on the Pocono Formation and

Table 9. *Summary of Field Determinations of Well-Water-Quality Characteristics*

Geologic unit	Specific conductance (micromhos at 25 °C) Number of wells	Percent[2] 10	Percent[2] 50 (median)	Percent[2] 90	Total hardness (mg/L as $CaCO_3$) Number of wells	Percent[2] 10	Percent[2] 50 (median)	Percent[2] 90	pH (units) Number of wells	Percent[2] 10	Percent[2] 50 (median)	Percent[2] 90	Total iron[1] (mg/L) Number of wells	Percent[2] 10	Percent[2] 50 (median)	Percent[2] 90
Llewellyn Formation	12	83	200	595	12	34	85	167	12	5.8	6.8	8.1	5	0.7	2	6
Pottsville Formation	7	25	60	126	14	6	24	108	12	4.2	5.8	7.1	1	—	3.8	—
Mauch Chunk Formation																
Undifferentiated	31	87	230	320	37	31	85	138	22	5.4	7	7.8	15	.1	.6	2.2
Upper member	9	9	100	845	7	17	51	273	9	4.9	6.7	8.7	7	.6	1	2.8
Middle member	68	50	160	370	69	17	51	136	58	5.3	6.3	7.8	41	0	.2	.6
Pocono Formation	3	50	100	185	3	30	54	64	3	5.1	5.9	6.8	—	—	—	—

[1]Determined by Hach Kit IR-18B (use of the firm name in this report is for identification purposes only and does not imply endorsement by the U.S. Geological Survey or the Pennsylvania Geological Survey).

[2]Percentage of wells that have values less than or equal to the value shown.

Table 10. *Summary of Concentrations of Major Chemical Constituents and Physical Properties of Groundwater*

(Quantities are in milligrams per liter)

Constituent or property	Llewellyn Formation			Pottsville Formation			Mauch Chunk Formation, undifferentiated			Mauch Chunk Formation, upper member			Mauch Chunk Formation, middle member			Pocono Formation		
	No. of analyses	Median	Range	No. of analyses	Median	Range	No. of analyses	Median	Range	No. of analyses	Median	Range	No. of analyses	Median	Range	No. of analyses	Median	Range
Silica (SiO_2)	8	6.9	6.0–11	10	4.6	3.3–6.6	11	9.0	4.8–17	3	4.7	4.5–6.3	11	12	4.8–17	2	—	—
Iron (Fe)	12	.81	.06–9	15	.15	0–6.5	29	.05	0–2.0	5	.27	.066–3.3	23	.04	0–1.3	4	.16	.1–3.4
Manganese (Mn)	9	.14	.002–.6	13	.08	0–.55	22	.01	0–.04	5	.013	.007–.33	22	.01	0–.11	2	—	—
Calcium (Ca)	12	20	3.1–59	13	2.7	.6–46	29	29	< 2.0–71	5	1.3	.3–21	23	26	2.5–125	3	10	5.6–12
Magnesium (Mg)	12	7.2	2.7–19	12	1.7	.5–7.1	26	3.4	.5–8.0	5	1.3	.2–5.3	23	2.9	.6–28	2	—	—
Sodium (Na)	12	4	.7–21	9	.7	.4–10	23	5.9	< .6–15	5	1.3	< .6–6.4	19	4.4	.7–36	2	—	—
Potassium (K)	12	.7	.0–4.7	9	.4	.2–.9	23	.4	.2–2.4	5	.4	.2–.8	18	.4	< .1–2.1	2	—	—
Bicarbonate (HCO_3), field	6	35	5–93	7	5	2–10	11	21	8–120	—	—	—	1	—	—	4	30	16–40
Alkalinity (as $CaCO_3$), laboratory	6	79	19–110	8	7.3	< 1.0–77	20	82	22–140	5	9	5.0–42	22	44	5.0–110	—	—	—
Sulfate (SO_4)	12	6.3	2–44	15	6	.0–39	27	10	< 1.0–66	5	5	< 1.0–5.0	22	9	< 1.0–280	3	3.5	3.0–9.0
Chloride (Cl)	12	4	1.2–330	15	1.8	.7–258	31	4	.8–50	5	2.1	.6–60	23	5	.5–120	4	5.9	1.0–7.8
Fluoride (F)	11	.1	.0–.2	14	.05	.0–.1	21	.1	.0–.3	5	.1	< .1–.1	23	.1	.0–.3	2	—	—
Nitrate (NO_3 as N)	10	.6	.02–16.0	9	.09	.00–.19	26	2.5	.00–9.30	—	—	—	15	1.5	.00–13.0	4	.29	.00–1.10
Phosphate (PO_4 as P)	—	—	—	5	.000	.000–.030	2	—	—	1	—	—	7	.01	< .010–1.80	2	—	—
Dissolved solids (residue at 180 °C)	6	152	51–241	8	53	13–565	11	67	20–261	—	—	—	6	162	53–773	3	52	38–65
Dissolved solids (residue at 105 °C)	4	139	126–846	—	—	—	15	174	12–366	2	—	—	9	146	48–386	—	—	—
Carbonate hardness (as $CaCO_3$)	12	86	21–209	15	15	6–82	31	81	8–204	5	9	2–75	23	75	9–426	4	30	26–54
Noncarbonate hardness (as $CaCO_3$)	12	13	0–187	14	8	0–67	31	8	0–89	5	0	0–66	23	28	0–406	4	10	0–26

the upper member of the Mauch Chunk Formation are based on insufficient data to be representative of water quality in these units. Excessive iron and manganese are the chief water-quality problems. Isolated occurrences of high chloride, sulfate, and nitrate are indicative of local or on-site conditions.

The results of analyses for trace elements in groundwater are shown in Table 11. Only one of the values determined exceeds U. S. Environmental Protection Agency water-quality standards. The sample from well Sc-400 contained 16,300 μg/L (micrograms per liter) of zinc, which is more than three times the Environmental Protection Agency standard of 5,000 μg/L. Another sample, from well Da-663 in Berrysburg, contained 4,000 μg/L of zinc, a value that is below the U.S. Environmental Protection Agency standard but anomalous to the area. The source of high zinc values was not iden-

Table 11. *Chemical Analyses of Trace Elements in Well and Mine Water*

(Quantities are in micrograms per liter)

Well number	Date of sample	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Nickel (Ni)	Zinc (Zn)	Aluminum (Al)
				LLEWELLYN FORMATION—MINE BOREHOLES					
Sc-299	7-20-77	<1	ND[1]	<2	ND	17	200	490	1,000
305	7-19-77	<1	ND	<2	ND	12	3	ND	40
	7-19-77	<1	2	5	ND	65	210	540	1,000
312	7-19-77	<1	ND	<2	ND	12	4	ND	80
	7-19-77	1	ND	ND	ND	15	440	100	50
313	7-20-77	5	ND	<2	ND	10	160	20	20
	7-20-77	3	ND	<2	ND	8	110	30	10
				LLEWELLYN FORMATION—WELLS					
Sc-329	5-18-82	1	1	10	19	7	7	15	<100
366	4-21-82	1	<1	10	47	5	1	16	—
417	5- 6-81	1	<1	<10	—	1	<10	150	100
418	5- 6-81	1	<1	<10	—	0	<10	30	30
438	4-16-81	1	<1	20	—	3	<10	20	70
458	5-13-81	1	<1	<10	—	37	<10	400	60
				POTTSVILLE FORMATION					
Sc-205	6-18-64	—	—	—	—	—	—	—	0
236	3-30-65	—	—	—	—	—	—	—	100
513	5-10-82	1	<1	10	7	7	7	26	<100
				MAUCH CHUNK FORMATION, UNDIFFERENTIATED					
Cb-121	5-10-82	1	<1	10	1	1	2	3	<100
Da-454	1- 4-73	<1	ND	ND	40	5	10	20	82
621	5-27-81	1	<1	10	—	2	10	30	60
626	4-15-81	1	<1	10	—	2	10	90	60
627	4-15-81	1	<1	10	—	1	<10	310	50
629	4-15-81	1	<1	<10	—	2	30	30	20
644	4-30-81	4	<1	<10	—	1	0	40	60
651	5-19-82	<1	<1	10	15	3	5	4	<100
652	5- 5-81	3	<1	20	—	1	20	10	30
653	5- 6-81	3	<1	<10	—	1	10	20	10
656	5- 6-81	5	<1	<10	—	1	<10	20	30
658	5- 6-81	3	<1	<10	—	1	<10	20	40
660	5-13-81	—	<1	<10	—	1	<10	20	60
661	5-13-81	2	<1	<10	—	1	50	20	40
663	5-13-81	1	<1	<10	—	4	<10	4,000	20
665	5-14-81	2	<1	<10	—	1	10	30	20
667	5-14-81	3	<1	<10	—	0	<10	20	10
668	5-14-81	2	<1	<10	—	1	<10	20	<10

Table 11. *(Continued)*

Well number	Date of sample	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Nickel (Ni)	Zinc (Zn)	Aluminum (Al)
MAUCH CHUNK FORMATION, UPPER MEMBER									
Sc- 400	4-15-81	0	1	10	—	10	40	16,300	1,040
408	4-16-81	10	1	1	310	25	50	10	60
516	5-11-82	2	< 1	< 10	4	4	3	3	< 100
MAUCH CHUNK FORMATION, MIDDLE MEMBER									
Da-604	5-18-81	3	< 1	< 10	—	3	< 10	20	80
Nu-205	5-18-81	3	< 1	< 10	—	1	< 10	30	10
227	5-20-81	1	1	< 10	—	1	10	10	10
Sc-406	4-15-81	1	< 1	10	—	4	30	70	210
453	5- 7-81	1	< 1	< 10	—	0	10	40	30
454	5- 7-81	1	< 1	< 10	—	26	20	50	60
457	5-13-81	4	< 1	< 10	—	1	< 10	20	50
478	5-19-81	5	< 1	< 10	—	2	< 10	30	< 10
484	5-20-81	2	< 1	< 10	—	2	< 10	50	10
POCONO FORMATION[1]									
Da- 9	10-13-72	< 1	5	< 2	40	1	10	200	< 100
10	10-13-72	< 1	5	< 2	< 20	1	ND	400	< 100

[1]ND, not determined.

tified but may be the use of galvanized pipes in the distribution system. Sporadic high zinc concentrations are present in other areas of the state (Wood and others, 1972), but the source commonly is not identifiable.

A comparison of the quality of water in the Llewellyn Formation from test boreholes in and near mine passages with water from private wells shows the magnitude of the effects produced by mining. Analytical results from samples collected prior to this study by the U.S. Geological Survey from mine boreholes and shafts are given in Table 12. A comparative summary of median values of constituents in water from mines and water-supply wells is shown in Table 13. All mine-water constituents have median concentrations that range from 3 to 40 times those from wells. Therefore, nearly all wells in the Llewellyn Formation that tap mine water will produce very poor quality water. Wells that are pumped for short periods at low rates, or that will not induce flow from mines by pumpage because they are sufficiently distant from mines, are expected to produce water of acceptable quality except for the iron and manganese concentrations. These constituents may have to be removed to make the water usable. Careful site selection based on mine locations and local geologic and hydrologic conditions may permit the development of a moderate supply of potable or near-potable water from the Llewellyn Formation. Such development will be uncommon, because few areas underlain by the Llewellyn have not been affected by mining.

CONTAMINATION OF AQUIFERS ADJACENT TO THE COAL FIELDS BY ACID MINE DRAINAGE

Reports of contamination by acid mine drainage in the Mauch Chunk Formation resulted in a reconnaissance of these sites as well as others that had the potential for contamination by acid mine drainage. Only one of 27 sites evaluated had water-quality characteristics of acid mine drainage.

Major criteria used to select the sites for visitation were the presence of lineaments (detected on aerial photographs) and faults (shown on geologic maps) that extend from the Llewellyn and Pottsville Formations into the Mauch Chunk Formation and areas underlain by the Pottsville and Mauch Chunk Formations downgradient from mine-drainage tunnels, coal waste piles, and strip mines and their dis-

Table 12. *Chemical Analyses of Mine Water from Boreholes and Shafts in the Llewellyn Formation*

(Quantities are in milligrams per liter unless otherwise indicated)

Site number[1]	Latitude Longitude	Date of sample	Sampling depth (feet)	Temperature (°C)	Silica (SiO_2)	Iron (Fe) (μg/L)	Manganese (Mn) (μg/L)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrogen, nitrate (N)	Dissolved solids (residue at 180°C)	Hardness ($CaCO_3$)	Hardness, noncarbonate ($CaCO_3$)	Specific conductance (μmho/cm at 25°C)	pH (units)
Nu-131	40°48′14″ 76°29′47″	8-15-78	230	12.0	—	1,800	—	—	—	—	—	—	15	—	—	—	—	—	—	85	6.7
138	40°47′01″ 76°33′45″	8-15-78	220	14.5	—	18,000	—	—	—	—	—	—	1,800	—	—	—	—	—	—	2,080	4.4
139	40°48′07″ 76°26′54″	8-15-78	270	14.0	—	33,000	—	—	—	—	—	—	410	—	—	—	—	—	—	720	5.8
144	40°46′37″ 76°34′09″	8-15-78	260	14.0	—	14,000	—	—	—	—	—	—	200	—	—	—	—	—	—	770	7.9
145	40°47′04″ 76°33′33″	8-15-78	170	15.0	—	770	—	—	—	—	—	—	15	—	—	—	—	—	—	1,060	7.8
149	40°46′18″ 76°29′24″	8-15-78	140	13.0	—	60	—	—	—	—	—	—	6.1	—	—	—	—	—	—	155	9.5
154	40°47′48″ 76°27′03″	8-15-78	320	12.5	—	1,600	—	—	—	—	—	—	230	—	—	—	—	—	—	540	8.1
Sc-298	40°49′35″ 76°08′19″	8-14-78	140	10.0	—	8,600	—	—	—	—	—	—	200	—	—	—	—	—	—	455	4.0
299	40°48′38″	7-20-77	130	16.0	20	35,000	6,000	53	27	8.2	2.1	0	300	8.7	.1	.02	533	244	240	590	4.6
	76°09′12″	8-14-78	130	14.0	—	25,000	—	—	—	—	—	—	140	—	—	—	—	—	—	530	5.4
300	40°48′56″ 76°07′35″	8-14-78	130	12.0	—	10,000	—	—	—	—	—	—	130	—	—	—	—	—	—	420	4.5
305	40°47′37″	7-19-77	100	14.0	.5	190	40	28	11	25	4.3	15	110	31	.1	.01	228	116	104	370	7.8
	76°15′14″	7-19-77	210	13.5	28	33,000	4,000	44	29	8.2	2.6	0	220	9.3	.1	.03	486	230	230	560	4.8
		8-11-78	100	12.5	—	2,200	—	—	—	—	—	—	64	—	—	—	—	—	—	280	8.5
		8-14-78	210	13.0	—	20,000	—	—	—	—	—	—	280	—	—	—	—	—	—	580	5.3
307	40°48′19″ 76°15′52″	8-14-78	180	11.5	—	56,000	—	—	—	—	—	—	540	—	—	—	—	—	—	930	5.7
308	40°47′36″ 76°19′27″	8-15-78	100	11.0	—	25,000	—	—	—	—	—	—	310	—	—	—	—	—	—	895	7.3
312	40°48′28″	7-19-77	80.0	16.0	.2	340	140	51	80	29	4.5	25	410	53	<.1	.02	759	457	436	5,840	7.5
	76°14′14″	7-19-77	262	15.0	14	26,000	8,000	120	100	24	2.3	8	680	46	<.1	.01	1,130	712	705	1,175	6.0
		8-14-78	262	13.0	—	15,000	—	—	—	—	—	—	510	—	—	—	—	—	—	940	5.5
		8-14-78	80.0	12.0	—	95,000	—	—	—	—	—	—	560	—	—	—	—	—	—	1,520	6.9
313	40°47′40″	7-20-77	130	16.3	11	34,000	15,000	260	160	11	2.3	150	1,100	6.1	.1	.00	1,870	1,311	1,191	—	6.1
	76°16′28″	7-20-77	—	16.5	11	27,000	15,000	270	160	13	2.3	160	1,100	5.8	.1	.03	1,860	1,336	1,206	1,700	6.2
[2]314	40°49′35″ 76°08′20″	8-14-78	—	9.5	—	2,400	—	—	—	—	—	—	240	—	—	—	—	—	—	560	3.4
316	40°48′03″ 76°12′33″	8-16-78	276	14.5	—	38,000	—	—	—	—	—	—	350	—	—	—	—	—	—	910	6.1

[1]For further information, refer to Reed and others (1987).
[2]Springdale shaft.

Table 13. *Comparative Summary of Selected Chemical Constituents in Water of the Llewellyn Formation in Mine and Water-Supply Wells*

(Quantities are in milligrams per liter unless otherwise indicated)

Property or constituent	Number of samples	Median values	
		Wells	Mine boreholes
Iron (Fe)	12	0.83	—
	25	—	18
Manganese (Mn)	9	.14	—
	7	—	6
Calcium (Ca)	12	20	—
	7	—	53
Magnesium (Mg)	12	7.2	—
	7	—	80
Sulfate (SO_4)	12	6.3	—
	25	—	280
Dissolved solids	6	152	—
(residue at 180 °C)	7	—	759
Specific conductance	11	186	—
(μmho/cm at 25 °C)	24	—	655
pH (units)	11	6.9	—
	25	—	6.1

charges. Most sites are on steep slopes of forested ridges and were not easily accessible. Not all sites meeting the criteria were visited because of limited time and accessibility. Some sites could be evaluated using available groundwater-quality data or base-flow stream water-quality data. Most on-site evaluations were based chiefly on field measurements of pH, specific conductance, iron, and temperature of water from springs or of base flow in small head-water streams. Low specific conductance also is an indication of low dissolved solids and, therefore, low sulfate. A high sulfate concentration is another indication of acid mine drainage. Sites that had no identifiable groundwater discharges could not be evaluated. Table 14 shows the results of the measurements.

Mauch Chunk Formation

Only one of 12 sites evaluated in the Mauch Chunk Formation had some water-quality characteristics suggestive of acid mine drainage. A well (Da-585) at the site near the balancing reservoir (controls rapid pressure fluctuations) northwest of Williamstown contained high levels of sulfate (Table 15), but there are several alternative sources of contamination. Low iron content suggests that the oxidation of this metal was almost complete. Therefore, the water, if it was acid mine drainage, probably did not migrate underground directly from a mine site; otherwise the iron would have remained in solution. The water also was very hard and contained concentrations of calcium that are above normal for the middle member of the Mauch Chunk Formation, but similar to acid mine drainage. Possible sources of contamination are (1) the deep mines to the north; (2) a large blanket of coal waste material spread upgradient along the ridge; and (3) possible acid mine drainage from the nearby abandoned Williamstown mine tunnel. About a mile to the west of well Da-585 is the Big Lick mine drainage tunnel. Field analysis of water from a well in a setting analogous to that of well Da-585, about one-half mile to the southwest of drainage from the Big Lick tunnel, shows no sign of contamination. Therefore, the most likely of these sources is leachate from the coal waste material. The water quality of the 1981 sample from well Da-585 is better than the water quality from a sample taken in 1977, suggesting that the cause of the problem may be now less a factor in the groundwater quality. Much of the coal waste material has now been removed.

Pottsville Formation

Concentrations of iron, manganese, and sulfate in water from wells, springs (Table 15), and small upland streams at base flow (Table 14) in the Pottsville Formation are commonly not much higher in mined areas than in unmined areas. For example, water from the Kemble Tunnel draining an area containing both underground and strip mines in the Pottsville Formation had an iron concentration of 0.6 mg/L (Table 14) and a low specific conductance. A similar iron concentration, a slightly higher specific conductance, and a sulfate concentration of 30 mg/L were measured at this site in April 1975.

It is concluded that the quality of natural groundwater from the Pottsville Formation has not been significantly degraded by acid mine drainage. Instead, the quality of the groundwater is similar to that of natural (nondegraded) water; that is, it has a low pH (4.0 to 5.5), low dissolved solids, low iron concentrations (below 1 mg/L), and a hardness of less than 35 mg/L (as $CaCO_3$). Furthermore, there is no conclusive evidence that acid mine drainage has affected the quality of groundwater anywhere in the Mauch Chunk Formation.

Table 14. *Field Water-Quality Measurements of Groundwater Discharges Subject to Contamination by Acid Mine Drainage*

Type of site	Latitude	Longitude	Name of 7.5-minute quadrangle	Date of site measurements	Temperature (°C)	pH (units)	Specific conductance (μmho/cm at 25 °C)	Dissolved iron (mg/L)	Hardness (mg/L)	Geologic unit	Remarks
Spring	40°45′28″	76°19′16″	Ashland	10-15-81	9.5	7.1	<50	0.0	<17	Mauch Chunk Formation, middle member	—
do.	40°45′36″	76°17′46″	do.	do.	10.0	4.5	<50	.6	<17	Mauch Chunk Formation, upper member	—
Spring Run	40°45′49″	76°17′13″	do.	do.	10.0	6.4	60	.5	<17	do.	—
Spring	40°45′45″	76°16′59″	do.	do.	9.0	4.7	<50	.5	—	Pottsville Formation	—
do.	40°45′49″	76°17′00″	do.	do.	9.0	—	65	.8	<17	do.	—
do.	40°46′32″	76°15′36″	do.	10-14-81	10.0	—	90	1.0	<17	do.	—
Shallow well	40°46′28″	76°15′15″	do.	do.	10.0	5.0	185	1.5	<34	Mauch Chunk Formation, upper member	Sc-365
Spring	40°46′30″	76°15′12″	do.	10-15-81	10.0	—	205	1.0	17	do.	About 150 feet from Sc-365
Spring Run	40°42′25″	76°18′59″	Minersville	11-18-82	8.5	4.4	30	.6	5	Pottsville Formation	—
do.	40°43′16″	76°17′46″	do.	do.	8.5	4.8	26	.5	4	do.	Above reservoir
Spring	40°43′20″	76°19′44″	do.	11- 5-82	10.5	4.0	180	.8	17	do.	—
do.	40°44′12″	76°18′43″	do.	11-18-82	10.0	4.6	60	.6	6	do.	See Table 15 for chemical analysis
do.	40°44′25″	76°19′27″	do.	do.	7.5	5.6	23	.0	7	Mauch Chunk Formation, upper member	—
Spring Run	40°40′45″	76°21′58″	do.	11-19-82	8.0	4.5	57	.9	10	Pottsville Formation	Headwaters of Swatara Creek
do.	40°40′03″	76°20′27″	do.	do.	9.0	5.6	147	10.0	51	Llewellyn Formation	—
Stream	40°45′45″	76°27′01″	Mount Carmel	12- 3-81	—	3.1	590	1.6	—	do.	—
Spring	40°47′54″	76°22′09″	do.	11-10-82	16.0	5.4	30	.8	—	Pottsville Formation	—
Spring Run	40°44′07″	76°02′43″	Orwigsburg	11-19-82	8.0	5.6	48	.3	12	Mauch Chunk Formation, middle member	—
do.	40°44′13″	76°02′44″	do.	do.	8.5	5.9	38	.4	13	do.	—
Spring	40°35′16″	76°25′27″	Pine Grove	11-16-82	10.0	5.2	32	.6	17	do.	—
do.	40°35′06″	76°27′37″	do.	do.	12.5	4.2	33	.6	<17	Llewellyn Formation	—
Spring Run	40°44′24″	76°12′47″	Pottsville	11-18-82	9.0	4.3	26	.2	4	Pottsville Formation	—
Spring	40°40′53″	76°10′10″	do.	11-19-82	7.0	5.2	45	.6	14	Mauch Chunk Formation, upper member	—
Stream	40°42′16″	76°23′18″	Tremont	11- 4-82	15.5	5.4	25	.8	—	Pottsville Formation	Strip mine drainage
Spring	40°41′50″	76°22′52″	do.	do.	12.0	3.7	20	.5	—	Pottsville and Mauch Chunk Formations	—
Spring Run	40°41′08″	76°25′23″	do.	11- 9-82	9.0	3.5	96	.8	—	do.	—
Spring	40°39′50″	76°25′10″	do.	do.	10.5	4.3	93	.6	28	Pottsville Formation	Kemble mine tunnel

SUMMARY AND CONCLUSIONS

Groundwater-flow systems are controlled chiefly by geologic structure and topography. There is no single system in the study area but rather many systems, ranging from less than one to several tens of square miles.

Underground mining has greatly altered the flow systems in the Llewellyn Formation. Networks of shafts and tunnels extend through most of the formation to depths as great as 2,000 feet. The original local flow systems now feed into the larger systems of mines that are the dominant drain of the Llewellyn Formation.

Groundwater-flow systems in the Mauch Chunk Formation range from unconfined to confined; some wells in valleys near the closure of major plunging synclines flow. The Mauch Chunk responds anisotropically to pumping; observed drawdowns were five times greater in wells along strike than in wells across strike. Significant interference occurs between wells spaced less than 1,500 feet apart along strike.

Ridge locations of the Pottsville Formation are recharge areas of the groundwater-flow system. Flowing wells occur in downslope and downgradient areas of broader plateaus, where a deeper confined system may underlie a shallow semiconfined system.

Yields of at least 75 gal/min can be obtained from about half of all wells located and developed for maximum production in the Mauch Chunk Formation. On the average, several hundred gallons per minute can be obtained from 25 percent of these wells. Half of the randomly located wells developed for domestic and small commercial use yield at least 18 gal/min. Groundwater discharge to streams from the Mauch Chunk averages 370 (gal/min)/mi^2, an amount sufficient to supply a population density of more than 5,000 people per square mile. Water is generally suitable for human consumption, but about 15 percent of the wells will produce water containing undesirable concentrations of iron.

The Pottsville and Pocono Formations mostly underlie rugged, steeply sloping ridges that are covered by undeveloped forest land. Half of the wells developed for maximum production in the Pottsville yield at least 75 gal/min. Few wells tap the Pocono, but the limited data available suggest that only domestic supplies can be obtained from this formation. Water from both the Pottsville and Pocono Formations is low in dissolved solids but may contain undesirable amounts of iron. Water from more than 40 percent of wells in the Pottsville contains iron or manganese in undesirable concentrations.

One half of the wells in the Llewellyn Formation yield more than 18 gal/min of water to wells. Groundwater discharge to streams from mined areas of the Llewellyn averages 580 (gal/min)/mi^2. A population density of more than 8,000 people per square mile could be supplied from this quantity of water. However, about 80 percent of wells not directly in contact with mines yield water that contains undesirable concentrations of iron or manganese. Wells in mined areas have 3 to 40 times the concentrations of iron, manganese, and dissolved solids as wells outside mined areas.

Reconnaissance and field water-quality measurements at sites adjacent to anthracite-mine areas indicate that adjacent aquifers have not been contaminated by acid mine waters. Future strip or underground mining in the Pottsville Formation on the ridge flank upgradient from the Mauch Chunk could degrade water in the latter aquifer. In areas of major groundwater pumpage in such settings, drawdowns would accelcrate such degradation.

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GLOSSARY

Acid mine drainage. Water discharged from coal mines; commonly contains high concentrations of iron, manganese, and sulfuric acid formed from the solution of sulfide minerals by groundwater.

Aquifer. A rock unit or group of units that is capable of supplying water to wells in usable quantities.

Base flow. The fair-weather flow of a stream. It is the portion of streamflow provided by the discharge of groundwater.

Confined groundwater. Groundwater under pressure significantly greater than atmospheric pressure; its upper surface is at the bottom of an impermeable rock mass, or bed.

Dip. The angle at which a formation or bed is inclined from the horizontal, measured at a right angle to the strike or trend of the formation or bed.

Direct runoff. Water that moves overland directly to streams after reaching land surface as precipitation.

Drawdown. A lowering of the pressure head or water level in a well as a result of withdrawal of water.

Evapotranspiration. Water withdrawn from a land area by direct evaporation and by plant transpiration.

Fault. A fracture or fracture zone along which there has been displacement of the two sides relative to each other. The displacement may be a few inches or many miles.

Fold axis. An imaginary line on the surface of a bed or rock unit through the trough of a syncline or on the crest of an anticline.

Groundwater basin. A portion of the crust of the earth bounded by groundwater divides. It acts as a unit to collect, store, and discharge all groundwater within its boundaries.

Groundwater divide. A ridge in the water table or other potentiometric surface from which the groundwater associated with that surface moves away in opposite directions.

Hardness. A chemical property of water, caused mostly by the presence of calcium and magnesium, which increases the amount of soap needed to produce lather. Water having a hardness (calculated as milligrams per liter of calcium carbonate) less than 60 is soft; between 61 and 120 is moderately hard; between 121 and 180 is hard; and greater than 180 is very hard. Field-determined values reported in grains per gallon were converted to milligrams per liter by multiplying by 17.1.

Hydrograph. A graph showing depth, flow, velocity, or other characteristics of water with respect to time.

Joint or fracture. A surface of actual or potential break or parting in the rock, along which no displacement has occurred.

Lineament. A natural linear feature visible on aerial photographs that is believed to be due to the

intersection of the land surface with a fracture zone in the rock.

Permeability. The capacity of a material to transmit a fluid.

pH. The negative logarithm of the hydrogen-ion activity. A pH of 7.0 indicates a neutral solution; values higher than 7.0 denote alkaline solutions; values lower than 7.0 indicate acidic solutions.

Plunge. The vertical angle between a horizontal plane and a linear structure such as a fold axis.

Potentiometric surface. The surface that represents the static head for water in an aquifer and is generally defined by the levels to which water rises in tightly cased wells.

Rock unit. Any mass of bedrock or unconsolidated material that has been mapped as an entity and given a name; rock units have characteristic features that permit them to be separated from other rock units.

Specific capacity. The yield of a well divided by the drawdown necessary to produce this yield; expressed as gallons per minute per foot of drawdown.

Specific conductance. A measure of the ability of water to conduct an electrical current; conductance increases with increasing concentration of dissolved minerals.

Specific yield. The ratio of the volume of water that rock and soil, after being saturated, will yield by gravity to the volume of the rock or soil.

Stream basin. An area that is drained by a stream and all of its tributaries.

Strike. The compass bearing of a horizontal line in the plane of an inclined surface.

Strip mine. An open-cut mine in which material overlying the coal bed is removed before the coal is taken out.

Unconfined groundwater. Groundwater that is not confined under pressure beneath impermeable rock.

Water table. The upper surface of an underground zone that is water saturated. It conforms in general with the land surface.

Water year. The 12-month period of time beginning on October 1 and ending on September 30, designated by the calendar year in which it ends.

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM UNITS (SI)

Multiply inch-pound units	*by*	*To obtain SI units*
	Length	
inch (in.)	2.540	centimeter (cm)
foot (ft)	.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	.003785	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	.02832	cubic meter per second (m^3/s)
gallon per minute (gal/min)	.06308	liter per second (L/s)
gallon per day (gal/d)	.003785	cubic meter per day (m^3/d)
gallon per minute per square mile [$(gal/min)/mi^2$]	.2436	liter per second per square kilometer [$(L/s)/km^2$]
million gallons per day (Mgal/d)	3,785	kiloliter per day (kL/d)
	Temperature	
degree Fahrenheit (°F)	$°C = 5/9(°F - 32)$	degree Celsius (°C)
	Specific Capacity	
gallon per minute per foot [(gal/min)/ft]	.2070	liter per second per meter [(L/s)/m]
	Specific Conductance	
micromhos (μmho)	1.0	microsiemens (μS)

Milligrams per liter (mg/L) is an expression of concentration that is equivalent to parts per million (ppm) and is equal to 1,000 micrograms per liter (μg/L).

Table 15. *Chemical Analyses*

(Quantities are in milligrams per

Well number	Date of sample	Temper-ature (°C)	Silica (SiO_2)	Iron (Fe) (µg/L)	Manga-nese (Mn) (µg/L)	Calcium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate, field (HCO_3)
										LLEWELLYN
Sc- 64	8-31-31	—	8.0	100	—	21	6.8	7.8	1.6	51
188	5- 5-49	—	6.8	830	—	19	8.1	21	2.9	73
190	5- 4-49	—	8.5	1,200	—	18	11	3.1	1.7	18
231	1-18-63	15.6	8.5	8,200	600	18	9.2	3.6	.0	93
232	1-23-63	13.3	6.0	310	100	5.2	2.7	2.0	1.2	6
233	2-12-59	7.2	6.9	160	30	20	19	21	4.7	5
329	5-18-82	11.0	6.7	9,000	280	12	5.3	.7	.3	—
366	4-21-82	12.0	11	59	2	3.1	3.3	3.1	.2	—
417	5- 6-81	—	—	700	180	29	6.1	4.3	.3	—
418	5- 6-81	—	—	1,500	140	30	5.9	2.9	.3	—
438	4-16-81	—	—	1,200	140	23	7.6	10	.4	—
458	5-13-81	—	—	780	440	59	15	11	1.0	—
										POTTSVILLE FORMATION,
Cb-Sp-3	2-21-52	6.0	3.3	10	—	5.2	2.9	1.1	.9	5
	6-25-54	8.0	4.5	150	—	6.6	2.1	—	—	6
Co- 587	11-10-82	10.0	5.5	2,500	160	1.2	1.4	.6	.4	—
Sc- 12	11-18-82	10.0	4.0	8	82	1.1	.9	6.8	.6	—
176	10-11-73	—	—	30	30	—	—	—	—	4
200	10-23-73	—	—	660	70	—	—	—	—	10
205	6-18-64	—	3.6	1,600	80	1.6	.5	.4	.2	5
235	3-30-65	9.4	4.7	80	0	1.6	1.2	2.0	.5	5
236	3-30-65	11.1	4.4	5,200	550	4.4	2.7	10	.9	2
[1]322	6-12-81	11.0	6.6	6,500	440	2.7	1.7	.6	.3	—
[2]	6-12-81	11.0	6.5	5,300	340	1.5	1.6	.6	.3	—
332	4-22-71	—	—	0	1	27	1.8	—	—	—
333	7-25-72	—	—	0	0	46	—	—	—	—
512	5-11-71	—	—	3	1	18	7.1	—	—	—
513	5-10-82	10.0	6.6	3,400	200	.6	1.2	.7	.4	—
										MAUCH CHUNK FORMATION,
Cb- 21	9-23-30	10.0	—	—	—	<2.0	—	—	—	8
29	9-23-30	10.0	6.7	80	—	5.2	1.3	2.1	.2	21
35	9-23-30	12.0	—	—	—	3.0	—	—	—	14
	5-10-82	10.0	7.1	67	3	13	1.1	.6	.5	—
Da-Sp-1	8-31-31	—	—	—	—	3.0	—	—	—	19
Da- 22	8-31-31	—	17	150	—	50	5.7	12	2.4	120
31	9-24-73	—	—	60	40	—	—	—	—	11
454	1- 4-73	—	4.8	80	<10	4.4	.5	1.1	1.8	11
621	5-27-81	—	—	50	10	28	1.4	<10	<10	—
626	4-15-81	—	—	2,000	<10	28	2.7	2.2	.3	—
627	4-15-81	—	—	130	<10	45	1.8	5.5	.4	—
629	4-15-81	—	—	50	20	29	2.1	2.9	.3	—
644	4-30-81	—	—	<10	<10	41	4.8	5.7	.5	—
651	5-19-82	11.5	6.8	1,800	13	11	4.5	<.6	.3	—
	5-19-82	11.5	—	1,600	13	—	—	—	—	—
652	5- 5-81	—	—	20	10	42	4.2	7.3	.5	—
653	5- 6-81	—	—	50	10	32	3.4	6.0	.4	—
656	5- 6-81	—	—	30	10	28	2.2	14	.3	—
658	5- 6-81	—	—	50	10	44	5.2	5.9	.5	—
660	5-13-81	—	—	<10	<10	31	3.5	5.4	.4	—
661	5-13-81	—	—	<10	<10	30	3.1	6.1	.4	—
663	5-13-81	—	—	160	<10	71	6.4	9.7	.8	—

of Well and Spring Water

liter unless otherwise indicated)

Alkalinity ($CaCO_3$)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3 as N)	Orthophosphorus (PO_4 as P)	Dissolved solids (residue at 105°C)	Dissolved solids (residue at 180°C)	Hardness ($CaCO_3$)	Noncarbonate hardness ($CaCO_3$)	Specific conductance (μmho/cm at 25°C)	pH (units)	Well number
FORMATION												
—	6.5	21	—	5.00	—	—	132	80	38	—	—	Sc- 64
—	5.3	24	0.1	9.90	—	—	199	81	21	317	6.9	188
—	19	7.0	.0	16.0	—	—	173	90	75	145	6.7	190
—	10	2.4	.1	.05	—	—	99	83	7	186	6.5	231
—	14	2.4	.1	1.60	—	—	51	24	19	112	5.7	232
—	44	89	.0	.57	—	—	241	128	124	429	5.5	233
48	6.0	1.2	.1	—	—	—	—	52	4	120	6.2	329
19	2.0	2.4	<.1	—	—	—	—	21	2	72	6.9	366
110	5.0	3.0	.1	.02	—	140	—	98	0	180	8.0	417
110	<5.0	3.0	.2	.02	—	138	—	99	0	200	8.2	418
110	<5.0	5.0	.1	.02	—	126	—	89	0	205	7.5	438
22	11	330	<.1	.72	—	846	—	209	187	850	7.4	458
UNDIFFERENTIATED												
—	23	1.8	.0	.02	—	—	—	25	21	72	6.6	Cb-Sp-3
—	27	2.0	.0	—	0.000	—	—	25	20	67	6.1	
<1.0	8.0	.7	<.1	—	—	—	—	9	—	31	5.2	Co- 587
1.0	4.0	10	<.1	—	—	—	—	6	5	60	4.6	Sc- 12
—	6.0	1.0	.1	.15	.030	—	18	15	12	—	5.6	176
—	6.0	1.5	.1	.19	.010	—	28	16	8	—	5.9	200
—	4.2	.8	.0	.00	—	—	13	6	2	25	5.5	205
—	6.7	1.0	.0	.09	.000	—	20	9	5	29	5.5	235
—	9.2	25	.0	.14	.000	—	78	22	20	126	4.6	236
20	2.2	1.3	<.1	—	—	—	—	14	0	68	6.0	[1]322
2.0	2.6	2.1	<.1	—	—	—	—	10	8	58	6.5	[2]
77	.0	.9	.0	.00	—	—	90	74	0	—	7.1	332
50	5.0	9.0	—	.00	—	—	82	82	32	—	7.2	333
5.6	39	258	.0	.12	—	—	565	73	67	—	4.0	512
9.0	3.0	1.1	<.1	—	—	—	—	6	0	29	5.7	513
UNDIFFERENTIATED												
—	<2.0	1.0	—	.00	—	—	—	9	2	—	—	Cb- 21
—	1.6	1.5	—	.02	—	—	29	18	1	—	—	29
—	<2.0	2.0	—	.14	—	—	—	10	0	—	—	35
33	6.0	1.2	<.1	—	—	—	—	37	4	85	6.8	
—	1.0	1.0	—	.00	—	—	—	9	0	—	—	Da-Sp-1
—	66	2.6	—	.47	—	—	218	148	50	—	—	Da- 22
—	—	2.5	—	.00	—	—	20	8	0	—	5.7	31
—	7.0	2.0	<.1	.88	.030	—	42	13	4	45	5.7	454
80	<5.0	2.0	<.1	.16	—	112	—	76	0	175	—	621
76	25	6.0	.3	2.80	—	138	—	81	5	197	7.1	626
110	10	18	.2	.62	—	174	—	120	0	295	5.3	627
68	10	7.0	.2	2.40	—	120	—	81	13	195	6.1	629
100	25	8.0	.1	3.30	—	170	—	122	22	319	—	644
50	<1.0	.8	.1	—	—	—	—	46	0	105	5.7	651
—	—	—	—	—	—	—	—	—	—	105	5.7	
110	15	6.0	.2	7.70	—	192	—	122	12	300	—	652
100	5.0	3.0	.1	2.60	—	132	—	94	0	210	—	653
98	10	4.0	.1	2.00	—	176	—	79	0	230	—	656
100	10	19	.2	4.40	—	235	—	131	31	318	—	658
84	10	8.0	.2	4.40	—	12	—	92	8	240	—	660
72	15	4.0	.2	5.70	—	174	—	88	16	215	—	661
140	30	23	.2	8.70	—	366	—	204	64	420	—	663

Table 15.

Well number	Date of sample	Temperature (°C)	Silica (SiO_2)	Iron (Fe) (µg/L)	Manganese (Mn) (µg/L)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate, field (HCO_3)
Da- 665	5-14-81	—	—	<10	<10	45	3.8	6.9	.4	—
667	5-14-81	—	—	<10	<10	23	3.2	6.7	.4	—
668	5-14-81	—	—	<10	<10	49	6.1	12	.7	—
Sc- 11	9- 1-31	—	6.1	80	—	43	6.8	15	2.0	56
32	2-25-74	—	—	90	40	—	—	—	—	44
191	5- 4-49	10.3	9.3	330	—	18	1.4	1.9	.6	36
206	6-18-64	—	13	190	0	15	1.2	3.1	.2	52
286	3- 8-66	—	16	0	—	35	4.0	—	—	—
287	3- 8-66	—	9.0	0	—	40	8.0	—	—	—
323	3- 8-66	—	12	0	—	17	1.0	—	—	—
							MAUCH CHUNK FORMATION,			
Sc- 356	4-20-82	12.0	4.7	110	13	.9	.7	1.3	.2	—
400	4-15-81	12.0	—	2,190	150	1.3	1.3	2.3	.6	—
408	4-16-81	12.0	—	270	10	21	5.3	6.4	.8	—
515	5-11-82	10.0	4.5	66	7	.3	.2	<.6	.2	—
516	5-11-82	10.5	6.3	3,300	330	14	1.9	.8	.4	—
							MAUCH CHUNK FORMATION,			
Da- 585	6-21-77	—	—	0	0	125	28	—	—	—
	9-14-81	11.0	7.2	40	110	74	24	14	1.7	—
592	10- 6-77	—	—	0	—	100	7.8	—	—	—
604	5-18-81	—	—	30	20	26	2.4	3.9	.3	—
606	5-17-82	13.0	14	270	45	43	6.2	19	1.1	—
607	5-17-82	12.5	14	320	3	78	6.4	6.9	.4	—
Nu- 205	5-18-81	—	—	120	20	9.4	1.1	1.4	.2	—
227	5-20-81	—	—	30	10	19	2.3	4.2	.3	—
Sc- 224	12-26-62	—	17	240	0	16	3.4	2.6	.5	72
326	4-19-79	—	—	0	0	3.4	1.4	1.5	—	—
327	9- 2-64	—	12	1	0	6.4	1.2	—	—	—
328	4- 1-65	—	9.0	0	0	34	2.9	—	—	—
346	5-12-82	11.5	4.8	<3	2	2.8	1.1	.7	.8	—
351	5-18-82	12.0	13	41	2	52	3.2	7.4	.2	—
372	4-21-82	10.0	10	120	5	2.5	.6	1.7	<.1	—
379	5-12-82	12.0	13	1,300	33	26	10	36	2.1	—
406	4-15-81	—	—	360	<10	6.2	1.3	4.2	.4	—
453	5- 7-81	—	—	110	10	44	2.9	4.7	.4	—
454	5- 7-81	—	—	90	10	23	3.1	4.4	.6	—
456	5-12-82	11.5	8.4	<3	18	9.3	2.0	1.9	.7	—
457	5-13-81	—	—	<10	<10	65	4.7	8.1	.4	—
478	5-19-81	—	—	50	10	38	3.1	4.9	.3	—
484	5-20-81	—	—	70	10	26	2.0	4.9	.2	—
							MAUCH CHUNK FORMATION,			
Da- 577	3-14-72	—	—	100	—	—	—	—	—	130
										POCONO
Da-Sp-3	3-13-72	—	—	200	—	—	—	—	—	16
Da- 9	8-31-31	—	—	3,400	—	10	—	—	—	40
	10-13-72	—	7.1	100	<10	5.6	3.3	.8	.8	26
10	10-13-72	—	7.1	110	<10	12	5.8	.7	1.3	34

[1]Sample depth is 335 feet.
[2]Sample depth is 325 feet.

(Continued)

Alkalinity ($CaCO_3$)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3 as N)	Orthophosphorus (PO_4 as P)	Dissolved solids (residue at 105 °C)	Dissolved solids (residue at 180 °C)	Hardness ($CaCO_3$)	Noncarbonate hardness ($CaCO_3$)	Specific conductance (µmho/cm at 25 °C)	pH (units)	Well number
100	12	15	.1	5.50	—	224	—	128	28	320	—	Da- 665
80	3.0	2.0	.1	3.50	—	146	—	71	0	205	—	667
96	18	43	.1	6.60	—	308	—	147	51	310	—	668
—	18	50	—	9.30	—	—	261	135	89	—	—	Sc- 11
—	3.0	9.0	.1	.80	.050	—	70	52	16	—	6.8	32
—	7.6	5.2	.0	3.60	—	—	100	51	21	126	6.4	191
—	5.4	1.0	.0	.32	—	—	67	42	0	95	7.8	206
44	—	1.0	—	—	—	—	62	104	60	—	7.7	286
48	—	2.0	—	—	—	—	77	133	85	—	7.9	287
22	—	4.0	—	—	—	—	34	47	25	—	6.8	323
UPPER MEMBER												
6.0	< 1.0	2.1	< .1	—	< .010	—	—	5	0	—	5.8	Sc- 356
34	5.0	9.0	.1	—	—	174	—	9	0	90	7.8	400
9.0	5.0	60	.1	—	—	228	—	75	66	225	6.8	408
5.0	< 1.0	.6	< .1	—	—	—	—	2	0	9	5.0	515
42	5.0	.6	< .1	—	—	—	—	43	1	100	6.8	516
MIDDLE MEMBER												
21	—	1.3	.0	6.90	—	—	773	426	406	—	5.9	Da- 585
6.0	280	1.3	< .1	—	—	—	—	284	278	650	5.4	
85	78	31	.0	1.94	—	—	425	282	197	—	7.8	592
44	30	5.0	.2	.98	—	122	—	75	31	185	—	604
68	24	41	.1	—	1.80	—	—	133	65	475	6.6	606
103	18	64	.1	—	.040	—	—	221	118	660	7.4	607
26	5.0	2.0	.2	.06	—	48	—	28	2	75	7.8	Nu- 205
68	9.0	2.0	.1	1.50	—	146	—	57	0	130	—	227
—	2.5	1.0	.1	.70	—	—	80	54	0	120	7.7	Sc- 224
11	2.9	1.2	.1	.00	—	—	53	14	3	—	5.1	326
44	2.5	.7	.0	.00	—	—	100	21	0	—	6.4	327
80	7.7	10	.3	1.20	—	—	223	96	16	—	7.3	328
5.0	9.0	1.5	< .1	—	< .010	—	—	12	7	37	5.6	346
70	27	42	< .1	—	.010	—	—	143	73	345	7.6	351
13	< 1.0	.5	< .1	—	.040	—	—	9	0	22	6.5	372
12	< 1.0	120	< .1	—	.010	—	—	106	94	480	5.5	379
19	5.0	12	< .1	1.50	—	50	—	21	2	78	7.5	406
62	10	36	.1	4.00	—	276	—	122	60	260	7.8	453
42	15	7.0	.1	4.40	—	142	—	70	28	160	7.5	454
15	3.0	4.1	< .1	—	< .010	—	—	31	16	85	5.7	456
110	12	32	< .1	13.0	—	386	—	182	72	385	8.0	457
70	25	6.0	.1	6.40	—	228	—	108	38	225	—	478
70	< 5.0	4.0	< .1	6.00	—	170	—	73	3	220	—	484
LOWER MEMBER												
—	—	5.0	.0	.20	—	—	200	120	13	—	7.3	Da- 577
FORMATION												
—	—	7.8	—	1.10	—	—	52	26	13	—	5.9	Da-Sp-3
—	3.0	1.0	—	.00	—	—	—	32	0	—	—	Da- 9
—	3.5	4.0	< .1	.06	.030	—	38	28	7	50	6.8	
—	9.0	7.8	.1	.52	.110	—	65	54	26	100	5.1	10

Table 16. *Record*

Well location: The number is that assigned to identify the well. It is prefixed by the two-letter abbreviation of the county. The lat-long is the coordinates, in degrees, minutes, and seconds, of the well.

Use: C, commercial; D, dewater; H, domestic; I, irrigation; N, industrial; P, public supply; R, recreation; T, institution; U, unused; Z, other.

Topographic setting: F, flat; H, hilltop; S, hillside; V, valley; W, draw.

Aquifer: Pl, Llewellyn Formation; Pp, Pottsville Formation, undifferentiated; Ppm, Pottsville Formation, middle member; Ppl, Pottsville Formation, lower member; Mmc, Mauch Chunk Formation, undifferentiated; Mmu, Mauch Chunk Formation, upper member; Mmm, Mauch Chunk Formation, middle member; Mml, Mauch Chunk Formation, lower member; Mp, Pocono Formation.

Well location								
Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
								CARBON
Cb- 21	405305-754232	Jim Thorpe Municipal Authority	Ed Arner	—	P	960	V	Mmc/st
22	405245-754306	do.	—	—	P	800	V	Mmc/sh
29	405130-754521	do.	Ed Arner	—	P	800	S	Mmc/ss
35	404902-755135	Lansford Water Authority	A. W. Drake	—	P	1,100	V	Mmc/ss
36	404857-755133	Summit Hill Water Co.	Ed Arner	1905	P	1,100	V	Mmc/—
37	404858-755130	do.	A. W. Drake	—	P	1,100	V	Mmc/—
103	405258-754328	Car wash	Charles D. Moyer	—	C	895	S	Mmc/—
113	405257-754333	Frank Rincoe	Andrew S. Mermon	1970	H	880	S	Mmc/sssh
114	405124-754614	David Anderson	Charles D. Moyer	1970	H	945	S	Mmm/sssh
115	405103-754725	Herman Gehring	do.	1969	H	1,040	S	Mmm/sssh
117	404919-755128	Joseph Lanzos	Andrew S. Mermon	1968	H	1,140	S	Mmm/sssh
118	404918-755127	John Petro, Jr.	do.	1969	H	1,100	S	Mmm/sssh
121	405242-754310	Jim Thorpe Municipal Authority	Duane Moyer	1980	P	740	V	Mmc/sssh
122	405314-754347	do.	William Stothoff Co.	1978	P	1,100	S	Mp/ss
								COLUMBIA
Co- 487	405010-762154	Roaring Creek Water Co.	—	—	P	1,120	V	Mmc/—
488	405009-762156	do.	—	—	P	1,120	V	Mmc/—
587	404755-762239	Mount Carmel Borough Authority	—	1900	P	1,390	S	Pp/cg
								DAUPHIN
Da 9	403241-764837	Elizabethville Water Co.	Rulon and Cook, Inc.	—	U	870	S	Mp/—
10	403217-764910	do.	do.	—	P	920	S	Mp/—
20	403207-765455	Millersburg Home Water Co.	do.	—	P	440	V	Mmc/sh
21	403209-765459	do.	do.	—	P	440	V	Mmc/sh
22	403210-765530	Millersburg Water Authority	do.	1906	P	420	V	Mmc/sssh
31	403737-764754	Uniontown Water Co.	Shiffer Brothers	1930	P	620	S	Mmc/sh
400	403209-765505	Millersburg Water Authority	Kermit S. Snyder	1961	P	410	V	Mmc/sh
454	403143-765746	Berry Spring Water Co.	—	—	P	520	S	Mmc/sssh
577	403621-764245	Gratz Borough Authority	Kohl Bros., Inc.	1965	P	740	S	Mml/sh

of Selected Wells

Lithology: cg, conglomerate; ls, limestone; sh, shale; ss, sandstone; sssh, sandstone and shale; st, siltstone.

Static water level: Date measured—month/last two digits of year.

Reported yield: gal/min, gallons per minute.

Specific capacity: (gal/min)/ft—gallons per minute per foot of drawdown.
Rate (gal/min)—gallons per minute.

Hardness: mg/L, milligrams per liter.

Specific conductance: µmho/cm at 25 °C, micromhos per centimeter at 25 degrees Celsius.

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/ rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (µmho/cm at 25 °C)	pH (units)	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
COUNTY											
408	20	8	—	—	—	—	—	—	—	—	Cb- 21
300	20	10	—	—	—	—	2.0/250	—	—	—	22
606	36	8	—	46	—	—	—	—	—	—	29
250	40	8	—	27	1/28	—	—	—	—	—	35
250	40	10	—	9	1/18	—	2.7/161	—	—	—	36
250	40	10	—	5	1/18	—	4.2/227	—	—	—	37
120	61	6	80;118	70	—	—	—	—	—	—	103
151	74	6	95;135	41	7/81	12	.20/12	17	50	5.1	113
112	—	6	82;97;108	42	4/70	30	.71/30	34	130	5.0	114
98	41	6	76;94	21	5/69	25	.45/25	—	—	—	115
90	55	6	40;70	40	10/68	20	.61/20	—	—	—	117
110	77	6	50;80	50	4/69	30	1.2/30	—	—	—	118
450	53	8	69;90;156; 174;183;196; 206;217	—	9/80	800	8.0/800	34	85	6.8	121
814	—	—	—	—	7/78	—	—	—	—	—	122
COUNTY											
297	50	8	—	—	—	275	—	—	—	—	Co-487
302	50	10	—	—	—	400	—	—	—	—	488
75	—	6	—	—	11/82	—	.66/20	—	31	5.2	587
COUNTY											
400	15	8	—	—	—	3	—	—	—	—	Da- 9
200	15	8	—	—	—	—	—	—	—	—	10
300	—	8	—	2	8/31	50	—	—	—	—	20
500	—	8	300;500	2	8/31	150	2.4/150	—	—	—	21
300	—	8	—	20	1/06	—	.85/85	148	—	—	22
296	—	6	—	100	1/30	63	.36/63	—	—	—	31
300	42	8	—	—	—	—	5.6/112	120	—	7.7	400
270	94	6	—	—	—	—	.44/55	274	—	5.9	454
350	23	6	70;125;170; 268	35	1/65	—	.87/60	142	—	7.6	577

Table 16.

Well location Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Da- 585	403509-763727	Williamstown Borough Authority	—	1977	P	920	S	Mmm/—
592	403458-763458	Porter Tower Authority	Eichelberger Well Drilling	1977	P	703	V	Mmm/ss
600	403316-763303	Koppenhave	Paul T. Shiffer	1972	H	780	V	Mmm/—
601	403313-763305	Earl Romberger	do.	1974	H	800	V	Mmm/ss
602	403502-763659	Craig Solence	Harrisburg's Kohl Bros.	1973	H	840	S	Mmm/sh
603	403416-764455	R. Sites	Paul T. Shiffer	1978	H	760	S	Mmm/—
604	403454-763754	AMP Inc.	Eichelberger Well Drilling	1975	N	780	S	Mmm/—
605	403451-763510	Williams Jr.-Sr. High School	Kohl Bros., Inc.	1969	P	760	V	Mmm/sssh
606	403648-763959	Harry Unger	Paul T. Shiffer	1972	H	700	S	Mmm/ss
607	403641-764403	Lester Hoffman	Fred C. Shiffer	1973	H	762	S	Mmm/sh
608	403440-763827	Pennsylvania Game Commission	—	—	Z	760	S	Mmm/sssh
620	402357-765113	L. Coulson	Eichelberger Well Drilling	1979	H	440	S	Mmc/—
621	402321-765219	Jane King	do.	1976	H	415	S	Mmc/—
626	402251-765558	Dauphin National Bank	do.	1980	T	502	H	Mmc/—
627	402223-770005	G. Chepolis	do.	1980	H	300	V	Mmc/—
628	402342-765728	E. Sweitzer	Paul T. Shiffer	1978	H	545	H	Mmc/—
629	402412-765437	L. Weller	do.	1978	H	490	S	Mmc/—
640	403135-765740	L. Koppenhave	do.	1978	H	740	S	Mp/—
641	403355-765707	Jeff Messimer	do.	1979	H	535	V	Mmc/—
644	403422-765239	D. Hartman	Fred C. Shiffer	1980	H	550	S	Mmc/sh
645	403435-765437	Robert Troutman	Harrisburg's Kohl Bros.	1979	H	565	V	Mmc/—
651	403236-764935	F. Titus	Paul T. Shiffer	1978	H	710	S	Mmc/—
652	403326-765146	Roy Teter	Fred C. Shiffer	1979	H	578	S	Mmc/—
653	403321-764720	W. Leiter	Paul T. Shiffer	1978	H	662	V	Mmc/—
654	403344-764652	Gary Freeman	do.	1979	H	565	V	Mmc/—
655	403432-764723	H. Bender	do.	1978	H	602	V	Mmc/—
656	403427-764550	Usuka	do.	1974	H	625	S	Mmc/—
657	403409-764601	Ben Crabb	do.	1972	H	580	S	Mmc/—
658	403501-764853	Stephen Wise	do.	1979	H	662	V	Mmc/—
659	403507-764821	Gary Wise	do.	1974	H	638	S	Mmc/—
660	403649-764846	D. Engle	Fred C. Shiffer	1979	H	745	H	Mmc/—
661	403526-764932	G. Hostetter	do.	1979	H	682	S	Mmc/—
662	403611-764802	G. Pallas	Paul T. Shiffer	1978	H	720	H	Mmc/—
663	403609-764841	C. Mattis	Fred C. Shiffer	1979	H	725	V	Mmc/—
664	403412-764904	D. Neagley	Paul T. Shiffer	1975	H	602	V	Mmc/—
665	403632-764649	George Ressler	do.	1978	H	705	S	Mmc/—
666	403615-764919	M. Henninger	Harrisburg's Kohl Bros.	1979	H	682	S	Mmc/—
667	403446-765222	Elwood Strohecker	Paul T. Shiffer	1972	H	625	V	Mmc/—
668	403510-765046	Charles Troutman	do.	1972	H	702	H	Mmc/—
669	403747-764651	V. Gessner	Fred C. Shiffer	1979	H	665	H	Mmc/—
678	403241-764925	Donald Shadle	Paul T. Shiffer	1973	H	630	S	Mmc/sssh
680	403316-764809	Robin Landscaping	do.	1973	H	620	H	Mmc/sssh
682	403729-764821	C. Moore	—	1981	H	685	W	Mmc/sssh
684	403518-764941	Fred Shiffer	Fred C. Shiffer	1974	H	730	H	Mmc/sssh
686	403453-764638	Robert Rodichok	do.	1974	H	580	W	Mmc/sssh

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/rate (gal/min)	Hardness (mg/L)	Specific conductance (μmho/cm at 25°C)	pH (units)	Well number
250	—	6	—	—	—	70	—	426	—	5.9	Da-585
175	47	6	65;96	22	10/77	40	.57/30	—	—	—	592
112	64	5	80;105	30	8/72	20	.18/20	—	—	—	600
125	40	5	30;80;110	25	3/74	20	—	20	65	5.8	601
100	60	6	65;80	30	4/73	10	.14/10	—	—	—	602
205	41	6	85;185	40	8/78	20	.12/20	—	—	—	603
600	90	8	98;131;147; 162;233;477	43	9/75	—	.60/56	68	185	—	604
195	—	6	110;156;185	50	10/69	100	3.0/100	17	50	5.6	605
175	41	6	85	41	7/81	8	.07/8	120	400	6.2	606
80	21	6	75	20	6/73	11	.20/11	—	—	—	607
—	—	—	—	19	7/81	25	—	26	80	6.0	608
125	42	6	64;84;119	—	—	10	—	—	—	—	620
150	42	6	142	32	5/81	10	—	85	175	—	621
125	50	6	62;99;111	55	5/80	20	—	85	197	7.1	626
100	42	6	82	19	4/80	18	—	102	295	5.3	627
310	41	6	280	50	6/78	7	.03/7	102	220	—	628
143	62	6	100;138	40	6/78	12	.12/12	85	195	6.1	629
247	84	6	160;240	80	8/78	10	.13/10	—	—	—	640
205	40	6	120;200	38	7/79	15	.09/15	—	—	—	641
102	29	6	90;95;98	35	2/80	9	.18/9	119	319	—	644
180	50	6	90;160	50	8/79	12	.09/12	—	—	—	645
164	81	6	110;160	50	10/78	15	.14/15	—	—	—	651
111	43	6	90;107	30	10/79	9	.14/9	102	300	—	652
123	62	6	80;115	40	6/78	15	.19/15	102	210	—	653
180	61	6	175	35	11/79	30	.21/30	—	—	—	654
205	42	6	180	40	7/78	10	.06/10	—	—	—	655
172	33	6	110;160	50	6/74	20	—	85	230	—	656
155	33	5	90;140	35	11/72	25	.17/25	—	—	—	657
218	49	6	110;200	40	9/79	10	.06/10	136	318	—	658
176	38	6	100;160	40	4/74	6	.03/6	—	—	—	659
136	47	6	85;130	40	9/79	20	.33/20	85	240	—	660
80	20	6	50;75	25	11/79	25	.71/25	85	215	—	661
168	42	6	120;160	35	8/78	30	.23/30	—	—	—	662
130	103	6	125	65	8/79	20	.57/20	188	420	—	663
280	50	6	140;260	81	5/81	20	.07/20	—	—	—	664
143	42	6	140	30	10/78	50	.45/50	85	320	—	665
140	84	6	—	40	9/79	20	.20/20	—	—	—	666
155	33	5	110;140	30	8/72	30	.25/30	85	205	—	667
155	32	5	110;140	29	5/81	15	.10/15	154	310	—	668
114	46	6	85;94;112	35	12/79	12	.19/12	—	—	—	669
113	26	6	70;100	7	8/81	20	.24/20	17	50	5.5	678
155	30	6	90;140	46	8/81	8	.07/8	85	280	7.6	680
247	61	6	—	27	8/81	8	—	51	180	6.1	682
102	51	6	85;98	63	8/81	12	.80/12	85	280	7.8	684
150	29	6	90;146	47	8/81	11	.11/11	85	300	7.1	686

Table 16.

Well location Number	Well location Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Da- 688	403741-764716	Nevin Witmer	Fred C. Shiffer	1974	H	600	H	Mmc/sssh
689	403211-765517	Millersburg Water Authority	Harrisburg's Kohl Bros.	1963	P	440	V	Mmc/sssh
690	403333-765244	Elwood Stroup, Jr.	Fred C. Shiffer	1975	H	600	S	Mmc/sssh
692	403326-765548	Michael Weist	do.	1974	H	550	S	Mmc/sssh
693	403239-765743	—	—	1900	P	420	V	Mmc/sssh
694	403338-765416	Allen Kitchen, Jr.	Fred C. Shiffer	1974	H	540	H	Mmc/sssh
696	403358-765810	Ronald Spangler	Paul T. Shiffer	1974	H	550	S	Mmc/sssh
698	402238-765434	Central Pennsylvania Rifle Club	Harrisburg's Kohl Bros.	1967	R	420	S	Mmc/sssh
700	402251-765355	Mark Hoffman	do.	1972	H	380	V	Mmc/sssh
702	402447-765333	Norman Knapp	do.	1971	H	500	S	Mmc/sssh
704	402416-765437	Lawrence Shields	do.	1974	H	440	S	Mmc/sssh
706	402409-765506	Luther Shearer	do.	1969	H	420	V	Mmc/sssh
708	402335-765636	Raymond Labree	do.	1973	H	480	S	Mmc/sssh
710	402312-765616	Larry Teter	John Thran	1974	H	440	S	Mmc/sssh
712	402302-765731	Robert Dunkle	Harrisburg's Kohl Bros.	1972	H	400	S	Mmc/sssh
714	402251-765803	Elwood Smith	do.	1971	H	465	H	Mmc/sssh
716	402309-765834	Bruno Seiloff	do.	1966	H	460	W	Mmc/sssh
718	402306-765946	Harry Snyder	do.	1971	H	540	S	Mmc/sssh
720	403327-765533	Leroy Chubb	Paul T. Shiffer	1972	H	550	S	Mmc/sssh
722	403449-765603	Larry Mech	do.	1975	H	616	S	Mmc/sssh
724	403338-765439	Kenneth Fry	Fred C. Shiffer	1974	H	535	S	Mmc/sssh
726	403321-765718	Dennis Schaffner	Paul T. Shiffer	1974	H	500	S	Mmc/sssh
728	403243-765329	Charles Chubb	do.	1973	H	598	S	Mmc/sssh
730	403305-764957	Russell Snyder	do.	1975	H	640	S	Mmc/sssh
732	403330-764841	North Penn Co.	do.	1974	N	540	S	Mmc/sssh
734	403355-764650	Randy Wetzel	do.	1975	H	660	H	Mmc/sssh
736	403510-764728	Melvin Henninger	do.	1972	H	610	S	Mmc/sssh
738	403416-764511	Woodrow Mattern	Fred C. Shiffer	1973	H	730	S	Mmc/sssh
740	403508-764936	Harold Spaght	Paul T. Shiffer	1972	H	660	W	Mmc/sssh
742	403610-764838	I. Streub	Robert L. Brosius	1968	H	725	H	Mmc/sssh
744	403720-764835	Thomas Pope	Paul T. Shiffer	1972	H	670	W	Mmc/sssh
746	403744-764702	Lester Welker	do.	1972	H	665	H	Mmc/sssh
754	403332-764525	—	—	—	P	610	S	Mmc/—
756	403300-764751	—	—	1955	P	730	S	Mmc/—
								NORTHUMBERLAND
Nu- 85	404815-763440	Mourey	—	—	N	680	V	Mp/sssh
101	404701-764025	Trevorton Water Co.	E. W. Swank	1910	P	800	V	Mmc/ss
103	404702-762508	Mount Carmel Water Co.	Blanchard	1908	P	1,400	S	Mmc/ss
105	404648-764026	Trevorton High School	—	—	H	880	H	Mmm/—
163	404703-764006	Trevorton Water Co.	Wieand Brothers	1980	P	780	V	Mmc/st
205	404654-763942	Gary Troutman	Paul T. Shiffer	1978	H	940	S	Mmm/—
227	404435-763032	Clair Tobias	Alvin Swank and Son, Inc.	1981	H	805	S	Mmm/—
281	404742-763640	Daniel Breining	William Becker	1967	H	890	V	Mmm/sh
283	404710-763803	Albert Kerkilla	Roy Zimmerman	1967	H	980	S	Mmm/sh
285	404735-763635	Florence Schawlm	Robert L. Brosius	1967	H	960	S	Mmm/sh
287	404519-763312	Nevin Kerstetter	Roy Zimmerman	1968	H	1,010	S	Mmm/ss
289	404521-763245	Charles Lenig	do.	1966	H	1,000	S	Mmm/sh

(Continued)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/ rate (gal/min)	Hardness (mg/L)	Specific conductance (µmho/cm at 25°C)	pH (units)	Well number
110	25	6	82	45	8/81	20	.80/20	51	200	6.4	Da–688
300	24	8	—	20	1/63	—	.75/90	—	—	—	689
85	28	6	80	55	8/81	13	.62/13	102	290	7.8	690
97	25	6	50;76	32	8/81	13	.52/13	68	220	7.1	692
285	70	8	—	—	—	—	.81/125	—	—	—	693
170	—	6	—	94	8/81	—	—	85	320	7.3	694
122	76	6	—	26	8/81	15	.17/15	51	140	7.7	696
100	42	6	60;90	24	9/81	40	.53/40	—	—	—	698
80	30	6	50;65	8	9/81	12	.20/12	85	260	6.9	700
160	30	6	65;148	88	12/71	4	.06/4	—	—	—	702
200	41	6	80;150	56	5/74	12	.08/12	—	—	—	704
200	40	6	100;180	40	10/69	10	.07/10	—	—	—	706
200	40	6	112;168	50	9/73	25	.17/25	—	—	—	708
150	43	6	—	—	—	15	—	—	—	—	710
340	60	6	100;180	160	9/72	2	.01/2	—	—	—	712
180	43	6	90;160	—	—	15	.13/15	—	—	—	714
202	23	6	84;194	70	7/66	4	.03/4	—	—	—	716
100	60	6	70;90	25	10/71	7	.09/7	—	—	—	718
253	23	6	120;240	—	—	20	.08/20	—	—	—	720
145	42	6	80;135	30	2/75	20	.18/20	—	—	—	722
87	26	6	80;84	30	4/75	4	.17/4	—	—	—	724
128	28	6	90;120	35	4/74	8	.06/8	—	—	—	726
145	41	6	87;137	40	5/73	20	.20/20	—	—	—	728
263	20	6	180	—	—	3	.01/3	—	—	—	730
185	24	6	85;175	30	8/74	30	.17/30	—	—	—	732
305	47	6	190;290	45	8/75	4	.02/4	—	—	—	734
155	52	6	90;140	30	12/72	35	.29/35	—	—	—	736
114	40	6	75;90	70	10/73	20	.80/20	—	—	—	738
108	25	6	60;95	—	—	9	.08/9	—	—	—	740
120	24	6	112	22	4/68	—	—	—	—	—	742
155	31	6	80;120	35	10/72	15	.10/15	—	—	—	744
285	19	6	100;175	60	10/72	30	.14/30	—	—	—	746
200	—	—	—	—	—	50	—	—	—	—	754
278	—	—	—	—	—	70	—	—	—	—	756
COUNTY											
101	18	6	—	35	10/30	—	.80/20	—	—	—	Nu– 85
140	80	6	—	—	1/20	—	—	—	—	—	101
1,176	490	8	—	—	—	—	—	—	—	—	103
190	54	8	—	—	—	40	2.7/40	—	—	—	105
298	100	6	108;118;244; 246;251	—	7/80	—	4.3/90	120	260	—	163
174	85	6	80;160	30	6/78	25	.18/25	34	75	7.8	205
175	43	6	85;118	—	—	20	—	51	130	—	227
80	40	6	65	16	12/81	20	4.0/20	85	240	5.2	281
91	33	6	—	30	12/81	20	—	10	40	5.4	283
120	42	6	105	35	4/67	15	—	—	—	—	285
130	55	6	90;124	—	—	20	—	—	—	—	287
95	60	6	90	—	—	9	—	68	240	6.1	289

Table 16.

Well location: Number	Well location: Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
								SCHUYLKILL
Sc- 7	404639-761352	Mountain City Water Co.	Harrisburg's Kohl Bros.	—	U	1,420	S	Mmc/sssh
8	404639-761357	do.	do.	—	P	1,434	S	Mmc/sssh
9	404700-761400	do.	Blanchard	1915	P	1,460	S	Mmc/ss
10	404700-761400	do.	—	1912	P	1,460	S	Mmc/—
11	404705-761407	do.	A. W. Drake	1904	P	1,450	H	Mmc/—
12	405006-761141	Shenandoah Water Co.	—	—	P	1,540	W	Pp/—
13	405011-761134	do.	—	—	P	1,600	S	Pp/—
18	404856-760503	Blackwell	William Ray	—	H	1,260	S	Mmc/ss
19	404820-760727	German Cemetery	William W. Haldeman	—	H	1,700	S	Pp/—
20	405031-760647	Wyoming Valley Water Co.	—	1910	P	1,820	S	Pp/—
21	405041-760601	do.	—	—	P	1,740	W	Pp/—
24	405026-760417	do.	A. W. Drake	—	P	1,700	S	Pp/—
32	405353-760020	Honeybrook Water Co.	—	—	P	1,880	W	Mmc/—
37	405221-760746	Shenandoah Borough Water Co.	—	1904	P	1,000	V	Mmc/ss
42	405134-761348	Ringtown Hotel	C. Roach	—	H	1,080	V	Mmc/ss
43	405200-761418	Ferguson	Kohl Bros., Inc.	1928	H	1,080	S	Mmc/sh
63	404057-761156	Yuenglings Brewery	—	—	N	720	S	Pl/—
64	404056-761209	W. E. Treon Dairy	Ebbling and Binner	1922	C	720	S	Pl/—
130	404656-755737	Shelheimer	—	1928	N	860	V	Mmc/sh
131	404754-755757	Billman and Stegmaier	Ebbling and Binner	1922	N	900	V	Pl/sh
135	404928-755908	Saylor's Bakery Inc.	Elias Gessart	—	N	1,160	S	Mmc/ss
152	404610-761948	M. Miller	—	1931	H	960	S	Mmc/ss
153	404612-761950	Ashland State Hospital	Harrisburg's Kohl Bros.	1931	C	980	S	Mmm/ss
156	405606-761807	Immaculate Heart Academy	do.	1925	H	1,080	H	Mmc/—
157	405729-761846	Frackville Gas Co.	—	1928	N	960	V	Pp/sh
176	404716-761102	Citizens Water Co.	—	—	U	1,500	W	Pp/—
180	404553-760449	Blythe Township Water Authority	—	1950	P	1,219	V	Pl/—
188	404030-761630	David Zimmerman	—	1909	H	770	V	Pl/—
190	404230-760850	Rose Broch	—	1926	H	670	V	Pl/—
191	404920-755930	George Behler	—	1928	H	1,170	F	Mmc/—
200	404716-761055	Morea Citizens Water Co.	—	—	P	1,495	S	Pp/ss
205	404653-761224	Joseph Fiorelli	—	1964	H	1,600	S	Pp/—
206	404732-760455	Steven Chaken	—	1961	H	1,200	S	Mmc/—
216	404104-761249	United Metal Cabinet Corp.	Kermit S. Snyder	1963	N	780	S	Pl/sssh
217	404054-761503	Extrudo Film Co.	do.	1962	N	690	V	Pl/sssh
219	404843-760055	Roy Turner	Kohl Bros., Inc.	1963	H	1,200	H	Mmc/sh
220	404843-760055	do.	do.	1957	H	1,200	H	Mmc/sh
222	404240-760444	Guer's Dairy	do.	1953	N	1,040	V	Mmm/—
223	404243-760445	James Guer	do.	1958	H	1,060	V	Mmm/—
224	403600-762334	Mary Mease	—	—	H	678	V	Mmm/sssh
231	403816-762410	Lester Tobias	—	—	H	860	V	Pl/—
232	403807-762426	C. A. Wetzel	—	—	H	900	V	Pl/—
233	404010-761925	J. G. Starr	—	1960	H	810	V	Pl/ss
235	404805-760716	Locust Valley Coal Co.	Kohl Bros., Inc.	1941	C	1,660	H	Pp/—
236	404758-760853	Paul Williams	Charles D. Moyer	1954	H	1,650	S	Pp/cg
240	404723-760723	Locust Valley Coal Co.	Locust Valley Coal Co.	1964	C	1,740	H	Ppl/cg
241	404725-760722	Locust Valley Golf Course	do.	1964	U	1,710	S	Ppl/cg

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (μmho/cm at 25°C)	pH (units)	Well number
COUNTY											
320	—	—	—	10	—	—	.92/200	—	—	—	Sc- 7
452	—	12	—	10	—	—	1.5/350	—	—	—	8
651	—	8	—	8	—	—	.39/45	—	—	—	9
520	—	10	—	8	—	—	.82/95	—	—	—	10
402	205	8	—	8	—	—	1.00/120	—	—	—	11
510	—	14	—	32	—	400	—	—	—	—	12
560	—	8	—	—	—	65	—	—	—	—	13
75	—	6	—	40	—	15	—	—	—	—	18
112	—	—	—	40	—	20	—	—	—	—	19
352	—	8	—	15	—	125	—	—	—	—	20
500	—	10	—	13	—	5	—	—	—	—	21
500	—	10	—	10	—	125	—	—	—	—	24
1,014	—	6	—	—	—	—	—	—	—	—	32
995	—	8	—	18	—	200	—	—	—	—	37
190	—	6	—	20	—	10	—	—	—	—	42
410	—	—	—	130	—	30	—	—	—	—	43
476	—	—	—	140	—	—	.40/55	—	—	—	63
96	—	6	—	13	9/31	—	—	—	—	—	64
100	30	8	—	8	—	—	1.5/25	—	—	—	130
116	30	6	—	15	—	30	—	—	—	—	131
205	65	8	—	13	—	—	1.4/60	—	—	—	135
455	30	6	—	70	—	—	6.3/30	—	—	—	152
418	—	10	30;111;380	155	—	—	2.9/65	170	470	—	153
620	50	8	—	105	1/25	45	—	—	—	—	156
120	55	8	—	18	—	75	—	—	—	—	157
280	—	6	—	—	—	—	—	—	—	—	176
1,048	26	3	870	—	8/50	—	—	—	—	—	180
115	—	—	—	30	—	—	—	—	—	—	188
50	—	30	—	40	—	—	—	—	—	—	190
104	—	6	—	—	—	—	—	—	—	—	191
383	—	8	—	20	—	—	—	—	—	—	200
67	—	6	—	34	6/64	—	—	—	—	—	205
118	—	6	—	7	—	—	—	—	—	—	206
358	43	8	—	80	11/63	—	.60/60	94	220	7.4	216
300	29	8	—	5	10/62	—	2.1/200	—	—	—	217
384	20	6	358;375	180	6/63	30	.15/30	—	—	—	219
150	17	6	56;104;133	23	11/57	25	.44/25	—	—	—	220
77	—	6	40;75	12	5/58	—	2.9/110	—	—	—	222
55	—	6	11;26;55	8	5/58	—	2.3/40	—	—	—	223
85	—	6	—	—	—	—	—	51	170	7.4	224
50	—	6	—	—	—	—	—	85	200	6.6	231
55	—	6	—	—	—	—	—	34	105	5.6	232
20	—	—	—	—	—	—	—	—	—	—	233
200	22	6	—	12	10/41	12	—	—	—	5.5	235
127	54	6	90;126	15	1/64	10	.35/10	—	—	5.8	236
190	—	6	—	—	—	—	—	—	—	—	240
190	—	6	—	—	—	—	—	—	—	—	241

Table 16.

Well location		Owner	Driller	Year com-pleted	Use	Altitude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Number	Lat-Long							
Sc- 242	404724-760720	Locust Valley Golf Course	Locust Valley Coal Co.	1964	I	1,655	S	Mmu/cg
243	404732-760710	do.	do.	1964	I	1,600	S	Mmc/cg
244	404733-760703	do.	do.	1964	I	1,600	S	Mmc/cg
245	404736-760717	do.	do.	1964	I	1,580	V	Mmu/cg
246	404738-760703	do.	do.	1964	U	1,510	V	Mmu/cg
247	404730-760742	Locust Valley Coal Co.	do.	1964	R	1,650	H	Mmu/st
254	404558-760853	WPAM	Kohl Bros., Inc.	1947	H	1,700	H	Mmc/st
262	404056-761213	Benjamin Boltz	Paul Kerrigan	1965	C	700	S	Pl/—
263	404052-761253	Pottsville School District	Kermit S. Snyder	1965	I	880	S	Pl/ss
266	404156-761935	Blythe Township Municipal Authority	Paul Kerrigan	1965	U	1,260	V	Pl/—
270	404454-760748	do.	do.	1965	U	1,420	S	Mmc/st
271	404453-760742	do.	do.	1965	U	1,480	S	Mmc/sh
272	404819-760119	Tuscarora State Park	do.	1965	P	1,050	S	Mmc/sh
273	404831-760059	do.	do.	1966	P	1,080	W	Mmc/sh
274	404821-760033	do.	do.	1965	P	1,040	S	Mmc/sh
278	404735-755600	Tamaqua Borough	—	1980	U	—	V	Mmc/st
280	405339-760135	Honeybrook Water Co.	—	—	P	1,740	V	Mmc/sssh
281	405354-760007	do.	—	—	P	1,740	V	Mmc/sssh
282	405354-760008	do.	—	—	P	1,740	V	Mmc/sssh
286	403819-763120	Hegins Township Authority	Andrew J. Nicholas and Co.	1950	P	720	S	Mmc/sssh
287	403833-762952	do.	Kohl Bros., Inc.	1962	P	740	V	Mmc/sssh
295	404650-760745	Locust Lake State Park	Kermit S. Snyder	1969	R	1,260	V	Mmc/sssh
296	404708-760707	U.S. Geological Survey	do.	1975	U	1,290	S	Mmc/sh
305	404737-761514	Pennsylvania Department of Environmental Resources	—	—	U	1,139	S	Pl/sssh
308	404736-761927	do.	—	1974	U	1,050	S	Pl/sssh
321	404309-761942	Blythe Township Municipal Authority	Moody Drilling Co., Inc.	1974	P	1,510	W	Pp/ss
322	404305-761940	do.	do.	1975	P	1,370	W	Pp/ss
323	403812-763124	Hegins Township Authority	Kohl Bros., Inc.	1967	P	780	S	Mmc/sh
325	404233-764350	Paulis Car Body Shop	Kermit S. Snyder	1978	C	630	V	Pl/ss
326	403537-763240	Tower City Borough Authority	Kohl Bros., Inc.	1967	P	930	S	Mmm/sssh
327	403546-763117	do.	do.	1964	P	935	S	Mmm/sssh
328	403520-763152	do.	do.	1964	P	760	V	Mmm/sssh
329	404517-760328	T. Edmonds	Kermit S. Snyder	1979	H	840	S	Pl/sssh
330	404733-761442	Pennsylvania Department of Environmental Resources	—	1974	U	1,130	V	Pl/—
331	404734-761439	do.	—	1974	U	1,130	V	Pl/—
332	404904-760521	Pennsylvania Department of Transportation	Harrisburg's Kohl Bros.	1971	U	1,720	H	Pp/ss
333	404906-760516	do.	F. L. Bollinger and Sons	1972	U	1,720	H	Pp/ss
334	404812-760239	David Fritz	Charles D. Moyer	1969	H	1,115	S	Mmm/sssh
335	404654-761527	Ashland Borough	—	1980	U	1,460	W	Mmm/sh
336	404909-760323	Ryan Township Building	Charles D. Moyer	1971	H	1,170	W	Mmm/sssh
337	404542-761803	William Price	Alvin Swank and Son, Inc.	1978	H	1,040	S	Mmm/sh
338	404915-760347	James Tolan	Kohl Bros., Inc.	1976	H	1,245	H	Mmm/sssh

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/ rate (gal/min)	Hardness (mg/L)	Specific conductance (μmho/cm at 25 °C)	pH (units)	Well number
190	—	6	—	—	—	—	—	—	—	—	Sc-242
190	—	6	—	—	—	—	—	—	—	—	243
190	—	6	—	—	—	—	—	—	—	—	244
190	—	6	—	—	—	—	—	—	—	—	245
190	—	6	—	—	—	—	—	—	—	—	246
190	—	6	—	—	—	—	—	—	—	—	247
139	45	6	—	81	—	—	—	—	—	—	254
325	—	—	—	6	1/65	—	.17/17	—	—	6.8	262
187	—	—	—	—	—	—	—	—	—	—	263
162	—	7	—	—	—	—	—	—	—	—	266
500	13	6	—	—	—	—	.25/30	—	—	—	270
525	10	6	—	—	—	—	—	—	—	—	271
275	40	8	—	83	2/66	80	5.5/80	—	—	—	272
400	14	8	382	89	2/66	65	1.6/65	—	—	—	273
275	42	6	—	39	3/66	20	.52/20	—	—	—	274
400	70	10	—	—	—	150	—	—	—	—	278
961	—	—	—	—	—	250	—	—	—	—	280
375	—	—	—	—	—	600	—	—	—	—	281
374	—	—	—	—	—	500	—	52	—	6.7	282
170	29	8	—	5	9/50	—	1.00/100	—	—	—	286
198	28	8	54;109;198	11	9/62	—	2.7/380	—	—	—	287
254	57	8	—	5	4/69	300	8.6/300	18	—	6.4	295
242	40	7	97;220	43	7/75	2	—	—	—	—	296
213	170	8	—	56	4/77	—	—	—	—	—	305
144	19	8	—	15	9/76	—	—	—	—	—	308
602	30	8	137:212;407	—	—	—	6.2/50	38	—	6.8	321
647	30	8	94;214;242; 252;356;548	—	—	—	13/100	38	65	6.5	322
405	60	6	—	—	—	—	.60/70	—	—	—	323
122	42	6	50;68;95	1	12/78	—	.60/30	—	—	—	325
500	34	8	50;110;165	63	4/79	—	5.4/75	—	—	—	326
500	81	6	96;130;147; 162;256;354	58	8/64	—	1.5/108	—	—	—	327
500	31	8	38;53;85;160	8	8/64	—	.66/115	—	—	—	328
142	41	6	63;120;135	68	4/79	—	1.2/40	85	160	—	329
560	87	8	—	—	—	—	—	—	—	—	330
446	85	8	—	—	—	—	—	—	—	—	331
580	40	6	80;280	125	7/72	10	.07/10	—	—	—	332
400	45	6	65;180	121	6/72	21	.35/21	—	—	—	333
98	21	6	63;92	30	5/69	21	.52/21	51	162	6.5	334
425	20	6	—	4	8/81	15	—	17	80	7.1	335
300	25	6	192;296	37	10/71	10	.04/10	68	310	6.0	336
300	—	—	—	74	8/81	5	—	17	75	6.5	337
320	42	6	310	58	5/76	20	.08/20	34	76	5.6	338

Table 16.

Well location Number	Well location Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Sc- 339	404616-761740	Malcolm Boyer	William W. Reichart	1968	H	1,080	H	Mmm/st
340	404923-760405	Lynn Purnell	Charles D. Moyer	1974	H	1,273	W	Mmm/sssh
341	404627-761640	G. Watkins	—	1980	R	1,120	W	Mmm/st
342	404944-760309	Larry Light	Kermit S. Snyder	1977	D	1,245	S	Mmm/sssh
343	404622-761738	James Samelko	Robert D. Grant	1978	H	1,080	H	Mmm/st
344	404946-760314	S. P. Fegley	Kermit S. Snyder	1977	H	1,260	S	Mmm/sssh
345	404622-761746	R. Wetzel	—	1979	H	1,040	W	Mmm/st
346	404506-760204	Henry Inama	Andrew S. Mermon	1976	H	1,120	S	Mmm/sssh
347	404545-761910	Ellis Paul	Kohl Bros., Inc.	1977	H	1,070	H	Mmm/sssh
348	404431-760119	Robert Lemasters	Kermit S. Snyder	1969	H	960	W	Mmm/sssh
349	404610-761919	Anthony Baran	do.	1977	H	950	W	Mmm/sssh
350	404914-760346	Gene Soult	Charles D. Moyer	1975	H	1,242	H	Mmm/sssh
351	404605-761936	Joseph Baran	Kermit S. Snyder	1981	H	920	S	Mmm/sh
352	404651-761238	Lucy Gera	do.	1968	H	1,585	S	Mmu/cg
353	404558-762003	Fountain Springs Country Club	Alvin Swank and Son, Inc.	1980	I	910	W	Mmm/sssh
354	405321-760639	Earl Lorah	Kermit S. Snyder	1975	H	1,240	S	Mmc/sssh
355	404603-761948	Anthony Baran	do.	1978	H	940	S	Mmm/sh
356	404647-761255	Titanium Wire Corp.	Kohl Bros., Inc.	1969	H	1,560	W	Mmu/ss
357	404614-761654	Melvin Johnson	Alvin Swank and Son, Inc.	1978	H	1,065	S	Mmm/—
358	404656-761445	John Chowansky	Kermit S. Snyder	1969	H	1,440	S	Mmm/sssh
359	404516-761911	Vicki Botella	—	—	H	970	S	Mmm/sh
360	404658-761443	Leonard Bolinsky	Kermit S. Snyder	1969	H	1,490	S	Mmm/sssh
361	404517-761915	Vicki Botella	—	—	U	960	S	Mmm/sh
362	404641-761324	Vincent Luscavage	Kermit S. Snyder	1976	H	1,490	S	Mmu/ss
363	404612-761840	William George	—	1971	H	1,020	H	Mmm/ss
364	404508-760201	Michael Hromyak	Andrew S. Mermon	1977	H	1,120	S	Mmm/sssh
365	404628-761515	Ashland Borough	Alvin Swank and Son, Inc.	1980	P	1,420	W	Mmm/sh
366	404045-761659	Chester Buglia	Kermit S. Snyder	1968	H	800	W	Pl/sssh
367	404533-762453	Charles Lucas	do.	1969	H	940	S	Mmm/sh
368	404249-760754	John Kauffman	do.	1976	H	760	S	Pl/sssh
370	404252-761003	Donald Kull	do.	1974	H	780	S	Pl/sssh
371	403714-762302	Tremont Municipal Authority	—	1976	P	750	V	Pl/sssh
372	405146-755920	Edward Zukovich	Andrew S. Mermon	1976	H	1,225	S	Mmm/sssh
373	403517-762527	John Brommer	—	1977	H	720	V	Mmm/sssh
374	404913-755911	Robert Smigo	Duane Moyer	1971	H	1,185	H	Mmm/sssh
375	403944-762911	Donald Artz	—	1979	H	1,025	H	Mmu/ss
376	404921-755815	James Frederickson	Charles D. Moyer	1973	H	1,100	S	Mmm/sssh
377	403910-763404	Toby Catherman	—	1979	H	750	H	Mmm/sssh
378	404929-755917	Russell Krout	Kermit S. Snyder	1976	H	1,155	F	Mmm/sssh
379	404317-762239	Mary Wintersteen	—	1973	H	1,030	S	Mmm/sssh
380	404705-755816	John Mateyak	C. G. Fair, Jr.	1970	H	930	S	Mmu/ss
381	403907-763234	Warren Harner	Paul T. Shiffer	1981	H	660	V	Mmm/sssh
382	404623-755830	Franklin Stahler	Leon J. Canfield, Sr.	1977	H	1,022	W	Mmm/sssh
383	403744-763311	Department of Mines	Kohl Bros., Inc.	1970	P	760	V	Mmm/sssh
384	404733-755651	John Trudich, Jr.	Andrew S. Mermon	1970	H	1,040	S	Mmm/sssh
385	403812-762407	Edward Miller	Kermit S. Snyder	1969	H	850	V	Pl/sssh
386	405208-755829	Robert Adams	Charles D. Moyer	1967	H	1,240	S	Mmm/sssh
387	403813-762405	Charles Barry	Kermit S. Snyder	1969	H	850	V	Pl/sssh
388	404409-760235	Curtis Merkel	Ralph N. Neeb	1973	H	980	V	Mmm/sssh

(Continued)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/rate (gal/min)	Hardness (mg/L)	Specific conductance (µmho/cm at 25°C)	pH (units)	Well number
242	18	6	80;212	—	—	3	—	117	360	6.8	Sc-339
225	78	6	197;218	84	7/74	10	.10/10	68	190	6.5	340
180	30	6	120	39	9/81	—	—	51	120	7.6	341
162	51	6	74;120	50	5/77	11	.10/11	51	112	6.0	342
230	—	—	—	69	9/81	7	—	85	210	6.0	343
142	64	6	92;120	45	5/77	18	.28/18	34	108	5.7	344
260	20	6	180	49	9/81	7	—	103	230	7.2	345
120	20	6	55;110	45	6/76	20	.44/20	17	50	5.5	346
460	21	6	410	128	3/77	40	—	85	245	7.9	347
90	21	6	34;56;85	41	12/69	30	.46/30	17	62	5.7	348
102	41	6	60;86	20	10/81	30	.50/30	137	440	—	349
200	63	6	182;196	55	11/75	12	.22/12	34	82	5.8	350
422	41	6	—	19	10/81	—	—	120	370	6.6	351
90	29	6	41;63	18	5/68	45	2.0/45	17	150	8.7	352
435	—	8	—	91	10/81	70	—	—	—	—	353
182	69	6	38;82	45	11/75	6	.05/6	34	95	5.8	354
322	41	6	—	47	10/81	15	—	154	420	6.8	355
158	—	—	48;55	15	1/69	—	15/20	—	20	5.8	356
150	60	6	90	52	9/81	16	—	51	120	7.5	357
153	40	6	50;103	130	10/69	10	.12/10	136	370	6.3	358
125	—	—	—	35	10/81	—	—	17	50	5.2	359
95	34	6	55;82	75	8/69	30	1.00/30	68	280	5.3	360
58	—	—	—	31	10/81	—	—	—	—	—	361
122	41	6	42;76;108	18	7/81	26	.32/26	34	98	4.9	362
185	—	6	—	77	10/81	20	—	35	120	7.1	363
135	25	6	50;105	39	7/81	10	.10/10	34	95	6.8	364
40	—	—	—	—	—	60	—	25	185	5.0	365
104	21	6	60;80;104	26	7/81	9	.09/9	34	72	6.2	366
70	20	6	5;70	33	12/81	36	—	10	65	5.9	367
202	41	6	29;71	21	7/81	2	.01/2	119	300	6.6	368
122	43	6	63;90	74	8/81	—	1.3/50	85	218	6.8	370
500	56	6	—	20	3/76	—	.09/18	51	200	6.7	371
128	71	6	60;105	33	7/81	20	1.00/20	17	50	5.8	372
101	100	6	—	8	10/81	50	—	17	50	6.7	373
198	41	6	118;141;189;195	57	7/81	12	.29/12	51	160	5.9	374
215	40	6	—	89	11/81	4	—	273	845	6.7	375
175	38	6	132;169	38	7/73	25	.30/25	51	130	6.8	376
378	—	6	—	60	11/81	—	—	85	240	7.6	377
122	44	6	82;96;112	20	5/76	25	.31/25	17	60	5.1	378
122	39	6	—	57	11/81	—	—	68	320	5.8	379
540	—	—	—	58	8/70	6	—	51	220	6.3	380
160	42	7	—	10	11/81	20	—	85	275	7.8	381
225	41	6	163;212	68	7/77	10	.05/10	68	235	6.1	382
305	43	8	52;85;135	52	10/70	—	.40/73	—	—	—	383
140	25	6	60;110	40	9/70	15	.38/15	17	50	6.2	384
57	35	6	12;41;54	12	8/69	20	.71/20	—	—	—	385
230	—	—	187;224	100	11/67	12	.12/12	34	100	5.5	386
56	35	6	12;43;54	12	8/69	20	.50/20	—	—	—	387
100	40	6	60;80;100	20	6/73	15	.30/15	68	245	6.3	388

Table 16.

Well location Number	Lat-Long	Owner	Driller	Year completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Sc-389	403815-762403	Charles Zimmerman	Kermit S. Snyder	1970	H	855	V	Pl/sssh
390	404457-762010	Anson Snyder	—	1972	H	910	S	Mmm/sssh
391	403945-762900	Blair Artz	Paul T. Shiffer	1975	H	1,040	H	Mmu/ss
392	404311-761138	Quirin Machine Co.	Kohl Bros., Inc.	1970	C	760	W	Pl/sssh
393	403940-762926	Russell Scheib	Paul T. Shiffer	1972	H	920	S	Mmu/ss
394	404920-760154	Edward Rodgers	Charles D. Moyer	1971	H	1,120	V	Mmm/sssh
395	404341-762313	Dan Green	Robert L. Brosius	1966	H	1,000	S	Mmm/sssh
396	404905-760309	Leo Popnick	Charles D. Moyer	1966	H	1,138	S	Mmm/sssh
397	405040-760222	Geo Olexis	do.	1967	H	1,260	S	Mmm/sssh
398	404911-760314	Henry Blume	do.	1966	H	1,150	S	Mmm/sssh
399	404900-760258	St. Richards	do.	1969	H	1,140	S	Mmm/sssh
400	404636-761332	Jack Rich Inc.	Kermit S. Snyder	1980	N	1,480	S	Mmu/ss
401	404655-761301	J. Makauskas	do.	1981	H	1,575	S	Mmu/sh
402	404658-761433	Swade	Charles D. Moyer	1975	H	1,480	S	Mmm/cg
403	404657-761503	F. Savakinas	C. S. Garber and Sons, Inc.	1980	H	1,500	S	Mmm/ss
404	404623-761752	D. Heintzelman	do.	1980	H	1,010	S	Mmm/—
405	404703-761948	C. Remaley	Kermit S. Snyder	1981	C	980	V	Pl/ss
406	404509-762025	L. Fetteroff	Paul T. Shiffer	1978	H	820	V	Mmm/sh
407	404926-761324	E. Schreppel	Kermit S. Snyder	1978	H	1,650	F	Ppl/ss
408	405120-761000	Brandonville Fire Co.	do.	1981	P	1,280	S	Mmu/ss
409	405135-761010	J. Sekula	do.	1977	H	1,190	V	Mmm/ss
410	405211-760935	D. Brocious	do.	1979	H	1,100	S	Mmm/ss
411	405058-761457	T. Semanchyk	do.	1979	H	1,080	V	Mmm/ss
412	405036-761457	K. Steidle	do.	1979	H	1,080	V	Mmm/ss
413	405047-761452	J. Campanicki	do.	1979	H	1,060	V	Mmm/—
414	405049-761449	J. Dillman	do.	1979	H	1,060	S	Mmm/—
415	403729-762343	W. Ochs	Myers Bros. Drilling Contractors, Inc.	1980	H	980	S	Pl/sh
416	403732-762336	R. Shott	do.	1979	H	860	S	Pl/ss
417	403758-762348	Tremont Nursing Home	Kermit S. Snyder	1979	H	800	V	Pl/ss
418	403813-762403	C. Gauker	Fisher's Well Drilling	1979	H	960	V	Pl/sh
419	403817-762405	D. Smith	Kermit S. Snyder	1978	H	940	V	Pl/ss
420	403816-762407	K. Graeff	Fisher's Well Drilling	1980	H	940	V	Pl/sh
421	403818-762405	T. Bressler	do.	1977	H	860	V	Pl/sh
422	403809-762441	E. Young	Kermit S. Snyder	1979	H	890	V	Pl/ss
423	403914-762105	F. Artz	do.	1980	H	980	S	Pl/ss
424	403923-762648	R. Straub	Fisher's Well Drilling	1980	H	930	S	Mmm/ss
425	403919-762640	Clair Dunkelberg	Fred C. Shiffer	1972	H	880	S	Mmm/sh
438	403729-762311	Hancock	Fisher's Well Drilling	1979	H	890	S	Pl/sh
451	403906-762741	John Johns	Harrisburg's Kohl Bros.	1978	H	1,040	S	Mmm/ss
452	403813-762941	D. White	Fred C. Shiffer	1979	H	960	S	Mmm/sh
453	403914-762839	Franklin Wolfgang	do.	1972	H	890	V	Mmm/sh
454	403929-762948	L. Geist	do.	1978	H	750	S	Mmm/sh
455	404127-762658	Elmer Maurer	do.	1972	H	900	V	Mmm/sh
456	404205-762624	Earl Kimmel	do.	1972	H	920	S	Mmm/ls
457	404516-762242	James Freed	Alvin Swank and Son, Inc.	1977	H	920	S	Mmm/—
458	403908-762054	R. Donmoyer	Kermit S. Snyder	1978	H	980	V	Pl/sh
463	404503-762007	R. Long	do.	1977	H	880	S	Mmm/ss
464	403537-763118	Kenneth Stoneroad	Fred C. Shiffer	1975	H	840	S	Mmm/sh

(Continued)

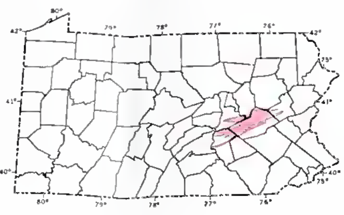
Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/ rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (μmho/cm at 25°C)	pH (units)	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
55	41	6	42;48;53	5	2/70	10	.29/10	—	—	—	Sc-389
150	60	6	—	35	8/81	—	—	17	60	8.2	390
190	34	6	120;175	45	6/75	6	.03/6	—	—	—	391
445	20	6	80	45	8/70	5	.04/5	—	—	—	392
275	34	6	140;250	60	8/72	5	.02/5	—	—	—	393
150	44	6	97;145	36	8/71	35	.42/35	—	—	—	394
350	22	6	180;220	40	11/66	3	—	—	—	—	395
96	55	6	60;90	18	9/66	25	.55/25	—	—	—	396
328	78	6	90;224	60	1/67	12	.05/12	—	—	—	397
96	37	6	66;91	21	7/66	30	.94/30	—	—	—	398
314	41	6	100;290;309	60	1/69	25	.12/25	—	—	—	399
162	41	6	56;148	10	12/80	20	.15/20	51	90	7.8	400
262	41	6	70;220	30	1/81	5	.03/5	—	—	—	401
577	—	6	425;552	105	11/75	30	.13/30	—	—	—	402
120	40	6	52;65;97	43	7/80	15	.19/15	17	50	—	403
140	20	6	65;110;120	50	8/80	10	.11/10	—	—	—	404
382	81	6	120;180;362	6	2/81	15	.04/15	—	—	—	405
100	64	6	30;60;90	20	7/78	25	.36/25	34	78	7.5	406
110	41	6	77;81;99	22	9/78	30	.56/30	51	150	—	407
142	81	6	40;85;128	23	1/81	20	.26/20	68	225	6.8	408
162	43	6	63;156	10	9/77	25	.30/25	102	245	7.2	409
402	41	6	52;200;278	200	11/79	2	.01/2	85	205	7.5	410
122	41	6	50;90;103	4	9/79	40	.87/40	222	1,190	6.8	411
122	41	6	55;75	8	9/79	50	1.2/50	68	255	—	412
202	80	6	83;140;181	10	9/79	20	.14/20	119	305	—	413
202	41	6	60;110;176	34	4/81	30	.27/30	51	150	7.2	414
125	82	6	89;117	—	5/81	—	—	—	—	—	415
100	61	6	74;92	—	—	20	—	—	—	—	416
302	68	6	69;170;215;290	8	11/79	100	.93/100	85	180	8.0	417
101	43	6	49;84	—	—	6	—	85	200	8.2	418
102	47	6	60;74	1	6/78	20	.34/20	—	—	—	419
80	60	6	65	—	—	12	—	—	—	—	420
81	51	6	75	—	—	20	—	—	—	—	421
162	61	6	63;80;120;150	10	8/79	12	.10/12	—	—	—	422
122	38	6	90;110	39	8/80	25	.41/25	—	—	—	423
101	—	—	74;97	—	—	25	—	—	—	—	424
109	39	5	65;105	40	11/72	7	.13/7	—	—	—	425
321	46	6	197	34	4/81	3	—	102	205	7.5	438
260	43	6	120;250	50	10/78	50	.24/50	—	—	—	451
85	63	6	65;80	35	3/79	20	.67/20	—	—	—	452
103	37	5	82;100	45	9/72	7	.15/7	102	260	7.8	453
122	44	6	86;98;115	50	6/78	18	.60/18	51	160	7.5	454
111	42	5	60;92;107	35	10/72	10	.16/10	—	—	—	455
145	37	5	100;132;140	40	10/72	4	.04/4	34	75	—	456
335	53	6	—	8	5/81	60	—	153	385	8.0	457
123	41	6	80;118	25	8/78	5	.06/5	188	850	7.4	458
162	39	6	60;97;150	40	11/77	40	.50/40	—	—	—	463
88	44	5	50;85	40	9/75	12	.38/12	—	—	—	464

Table 16.

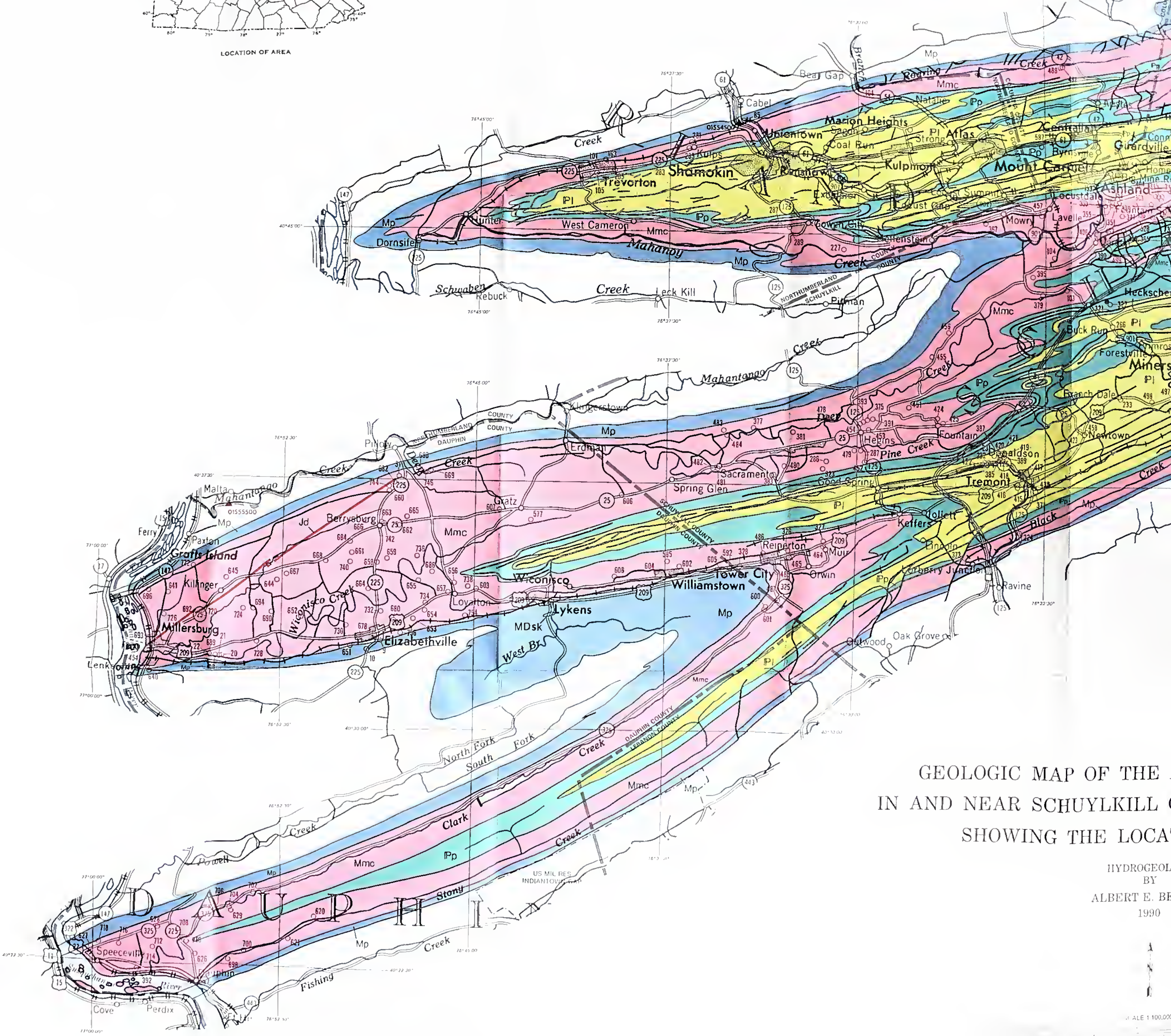
Well location Number	Lat-Long	Owner	Driller	Year com-pleted	Use	Alti-tude of land surface (feet)	Topo-graphic setting	Aquifer/ lithology
Sc- 465	403530-763241	Stanley Doe	Kermit S. Snyder	1974	H	850	S	Mmm/—
478	403929-763114	do.	Kohl Bros., Inc.	1977	H	720	S	Mmm/ss
479	403826-763011	J. Morris	Fred C. Shiffer	1978	H	785	S	Mmm/sh
480	403804-763249	B. Klouser	do.	1980	H	760	S	Mmm/sh
481	403802-763527	D. Schlegel	do.	1978	H	720	S	Mmm/sh
482	403802-763531	L. Deibert	do.	1979	H	715	S	Mmm/sh
483	403909-763515	M. Bixler	do.	1978	H	720	S	Mmm/sh
484	403858-763509	K. Stiely	Paul T. Shiffer	1978	H	690	S	Mmm/sh
485	403455-763305	Carl Melvin	Harrisburg's Kohl Bros.	1980	H	825	S	Mml/sh
486	403523-763342	G. Gonzalez	Fred C. Shiffer	1980	H	785	S	Mmm/sh
487	403401-763306	Robert Bowers	do.	1973	H	800	V	Mmm/sh
488	405417-760924	Cove Ski Village	—	1973	R	1,615	S	Mmc/st
489	405418-760922	do.	—	1973	R	1,620	S	Mmc/—
490	404406-760130	Richard Houtz	Charles D. Moyer	1969	H	900	V	Mmm/sssh
491	404527-760127	Leiby Zimmerman	do.	1969	C	1,070	S	Mmm/sssh
492	404940-760351	Daniel Rounds	do.	1974	H	1,303	S	Mmm/sssh
493	404505-760208	Frank Ohara	Andrew S. Mermon	1977	H	1,100	S	Mmm/sssh
494	404935-760159	Arthur Heckman	Charles D. Moyer	1971	H	1,190	W	Mmm/sssh
495	403906-761452	Schuylkill Municipal Authority	Jos. M. Mayer	1974	P	780	V	Mmu/ss
496	404016-761716	Walt Strenkoski	Kermit S. Snyder	1976	H	800	S	Pl/sssh
497	404015-761717	William Strenkosky	do.	1976	H	800	S	Pl/sssh
498	404003-761812	Albert Lords, Sr.	do.	1969	H	800	S	Pl/sssh
499	404458-762015	David Snyder	Roy Zimmerman	1967	H	920	S	Mmm/sssh
500	403924-761345	Schuylkill Municipal Authority	Kohl Bros., Inc.	1971	P	660	V	Mmm/sssh
505	405120-755957	John Powell	Charles D. Moyer	1966	H	1,140	S	Mmm/sssh
506	405016-755940	Edward Rarick	do.	1975	H	1,225	S	Mmm/sssh
507	404923-755828	Glenn Gearhard	do.	1971	H	1,100	H	Mmm/sssh
508	405002-755934	Lewis Stisowain	do.	1967	H	1,230	S	Mmm/sssh
509	404644-755849	John Stoudt	—	1966	H	1,080	F	Mmm/sssh
510	404716-755722	Ben Walters	Andrew S. Mermon	1970	H	970	W	Mmm/sssh
511	404732-765646	Reichelderfer	do.	1966	H	1,025	S	Mmm/sssh
512	404921-760504	Pennsylvania Department of Transportation	Harrisburg's Kohl Bros.	—	U	1,677	H	Ppm/—
513	404615-761341	Schuylkill Municipal Authority	Eichelberger Well Drilling	1980	U	1,520	V	Ppl/cg
514	404604-761432	do.	do.	1980	U	1,560	V	Pl/ss
515	404521-761018	do.	Kermit S. Snyder	1980	P	1,510	S	Mmu/ss
516	404611-761133	do.	Kohl Bros., Inc.	1973	P	1,370	V	Mmu/ss
517	404558-761301	do.	—	1972	U	1,310	V	Mmu/sh
518	404525-761220	do.	—	1972	U	1,250	V	Mmu/sh
528	404536-761838	James Fetterole	—	1982	H	980	S	Mmm/sssh
529	404551-761738	James Miller	—	1982	H	1,040	S	Mmm/sssh

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity [(gal/min)/ft]/rate (gal/min)	Hardness (mg/L)	Specific conductance (μmho/cm at 25 °C)	pH (units)	Well number
122	59	6	43;87;103	35	6/74	30	.46/30	—	—	—	Sc-465
120	25	6	82;101	38	6/77	30	.36/30	119	225	—	478
80	51	6	68;72	35	10/78	30	1.2/30	—	—	—	479
102	43	6	96	38	3/80	5	.11/5	—	—	—	480
96	35	6	75;90	25	6/78	12	.22/12	—	—	—	481
109	53	6	80;103	29	6/79	8	.13/8	—	—	—	482
80	35	6	75	10	1/78	25	.50/25	34	50	—	483
184	41	6	90;175	40	10/78	10	.07/10	119	220	—	484
130	39	6	70;125	—	5/81	—	—	—	—	—	485
83	59	6	76;81	40	3/80	25	1.7/25	—	—	—	486
112	34	5	85;108	35	10/73	10	.16/10	—	—	—	487
413	44	8	258;273;282; 413	58	1/73	—	1.4/125	46	—	7.3	488
397	55	8	221;305;397	88	1/73	—	.51/100	46	—	7.4	489
113	26	6	37;85;110	15	9/69	25	.38/25	—	—	—	490
407	45	6	254;296	70	7/66	22	.11/22	—	—	—	491
200	106	6	168;194	48	6/74	20	.24/20	—	—	—	492
120	30	6	55;95	55	1/77	18	.40/18	—	—	—	493
120	44	6	58;102	18	3/71	35	.83/35	—	—	—	494
400	50	8	—	—	—	150	—	—	—	—	495
262	42	6	102;211;250	46	11/76	20	.14/20	—	—	—	496
102	41	6	45;68;91	40	10/76	15	.47/15	—	—	—	497
82	22	6	30;55;82	50	4/69	—	36/36	—	—	—	498
135	35	6	—	—	—	12	—	—	—	—	499
200	36	8	55;80;120; 168	10	4/71	—	3.1/393	—	—	—	500
112	35	6	76;107	46	9/66	15	.26/15	—	—	—	505
200	108	6	155;185	15	5/75	20	.15/20	—	—	—	506
149	51	6	127;144	60	8/71	35	1.2/35	—	—	—	507
170	40	6	150;165	100	8/67	18	.36/18	—	—	—	508
214	41	6	64;179;207	55	6/66	11	.13/11	—	—	—	509
94	23	6	28;75	25	9/70	10	.17/10	—	—	—	510
122	33	6	55;118	60	9/66	20	.67/20	—	—	—	511
400	—	—	75;100;297	25	5/71	—	—	—	—	—	512
400	42	6	54;81	29	4/82	10	.32/7	—	29	5.7	513
425	42	6	52;79;272	12	11/80	12	—	—	—	—	514
404	41	6	50;75;90; 295;390	21	4/82	60	4.5/20	—	9	5.0	515
620	21	8	80;209;259; 270;435	—	10/73	213	.97/213	50	100	6.8	516
205	30	8	140;164	—	—	35	—	—	—	—	517
304	—	—	—	35	3/72	30	—	—	—	—	518
140	—	6	—	18	11/82	15	—	—	—	—	528
215	—	6	—	57	11/82	100	—	—	—	—	529

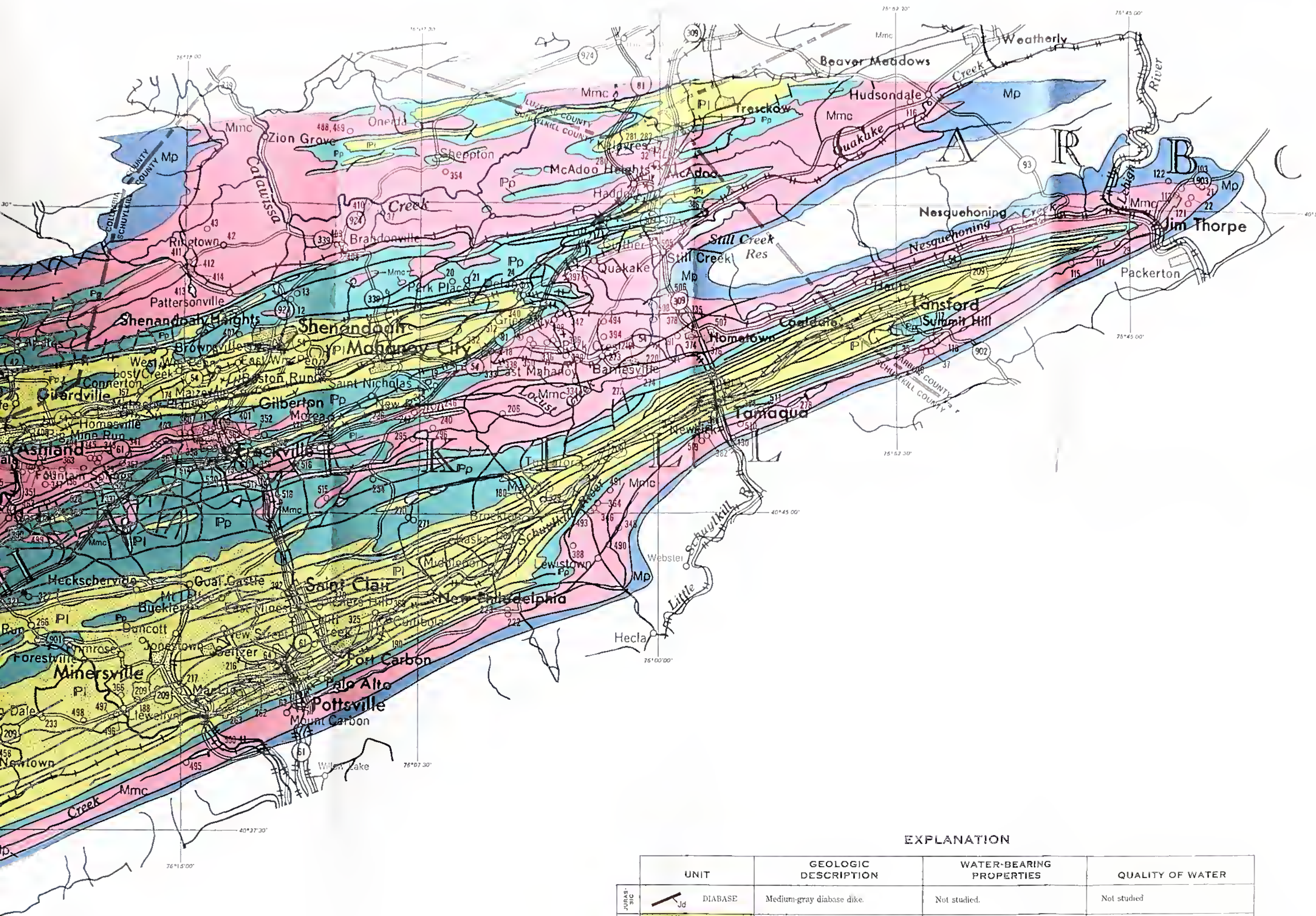


LOCATION OF AREA



GEOLOGIC MAP OF THE ...
IN AND NEAR SCHUYLKILL C...
SHOWING THE LOCA...

HYDROGEOL...
BY
ALBERT E. BE...
1990



OF THE ANTHRACITE REGION
UYLKILL COUNTY, PENNSYLVANIA,
THE LOCATIONS OF WELLS

HYDROGEOLOGY
BY
ALBERT E. BECHER
1990

SCALE 1:100 000

EXPLANATION

	UNIT	GEOLOGIC DESCRIPTION	WATER-BEARING PROPERTIES	QUALITY OF WATER
JURASSIC	Jd DIABASE	Medium-gray diabase dike.	Not studied.	Not studied
PENNSYLVANIAN	LLEWELLYN FORMATION Pl	Gray and brown interbedded sandstone, siltstone, and shale; some conglomerate beds; abundant anthracite coal beds.	Median specific capacity is 0.34 (gal/min)/ft for wells used to supply small production demands. Median and maximum reported yields are 20 and 100 gal/min, respectively.	Water is moderately hard (median 86 mg/L as $CaCO_3$) and has moderate concentrations of dissolved solids (median 152 mg/L). Objectionable concentrations of iron (median 0.81 mg/L) and manganese (median 0.14 mg/L) are commonly present in areas undisturbed by mining. In mined areas, unacceptable concentrations of iron (median 18 mg/L) and manganese (median 6 mg/L) are prevalent.
PENNSYLVANIAN	POTTSVILLE FORMATION Pp	Gray and some brown cobble and pebble conglomerate and conglomeratic sandstone. Upper part is coarsest grained. Contains some interbeds of sandstone, siltstone, shale, and anthracite coal.	Median specific capacity of all wells is 0.46 (gal/min)/ft. Median and maximum reported yields are 70 and 400 gal/min, respectively.	Water is soft (median 15 mg/L as $CaCO_3$) and low in dissolved solids (median 53 mg/L). Iron and manganese are commonly present in undesirable amounts, although the median concentrations are 0.15 and 0.08 mg/L, respectively.
MISSISSIPPIAN	MAUCH CHUNK FORMATION Mmc	Red, brown, and green siltstone, mudstone, shale, and very fine grained sandstone; contains a few calcareous nodules, lenses, or thin beds. Upper and lower members contain gray conglomerate and sandstone.	Median specific capacity for wells used to supply small production demands is 0.24 (gal/min)/ft and for wells used for large production demands is 1.1 (gal/min)/ft. Median and maximum reported yields are 28 and 800 gal/min, respectively.	Water is soft to very hard (median 90 mg/L as $CaCO_3$) and low in dissolved solids (median 80 mg/L). Water from about 10 percent of wells is high in iron (median 0.05 mg/L).
MISSISSIPPIAN	POCONO FORMATION[1] Mp	Gray sandstone, conglomeratic sandstone, and conglomerate; contains some siltstone, shale, and thin lenses of coal.	Insufficient data; few wells are drilled in this unit because it underlies high ridges. Based on the limited data available, wells drilled in the unit will probably be capable of supplying domestic needs.	Water from about 25 percent of wells is high in iron (median 0.16 mg/L). Water is soft (median 30 mg/L as $CaCO_3$) and low in dissolved solids.

[1] Includes a small area of the Spechty Kopf Formation of Mississippian and Devonian age (labeled MDsk on the map) near Lykens in Dauphin County.

SYMBOLS

Geologic contact
Includes approximately located and inferred contacts.

Fault
Includes approximately located and inferred faults.

○495
Well and county well number

●321
Observation well having a continuous recorder, and county well number

▲01555500
Stream-gaging station having a continuous record, and station number

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